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STAKEHOLDERS' INFORMATION NEEDS ON RADIOACTIVE WASTE MANAGEMENT

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ABSTRACT
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This Master's thesis aims at finding out the information needs and the preferred ways of access to information on radioactive waste management. This study is part of the project called European observatory for long-term governance on radioactive waste management (OBRA), which assesses the feasibility of creating a European observatory which would be a central point of reference for knowledge acquisition in the decision-making related to the siting process of the stakeholder groups, experts and the general public. The specific stakeholder groups addressed in this study include the residents of local communities, local decision-makers and professors and students in environmental and social sciences. This study focuses on the information needs related to the siting of a final disposal facility for spent nuclear fuel.

The information needs and preferred ways of access of local residents and decision-makers were studied reviewing previous relevant studies. Professors of different disciplines were interviewed in Sweden using a semi-structured interview and students at the universities of Lund and KTH using a group interview and a questionnaire. The results were analyzed to find similar patterns and distinctive views. The theoretical and conceptual context was gathered using relevant concepts from governance, knowledge-based view and stakeholder theory.

The information needs differed between stakeholder groups. The group of local residents was not very homogeneous, because it consisted of people with low level of knowledge on radioactive waste and on the other hand of concerned individuals, whose information needs were very precise. The local-decision makers needed information mainly on effects to local economy. The professors' information needs were dominated by demands of high level of academic qualities. The students saw a need for information, which was close to their field of study, as well as basic information. The common needs of information were the need for a general overview.

Also the different information practices and therefore the preferred ways of access to information differed. The experienced need for information did not always result to active search for information. Out of the selected stakeholder groups, the local decision-makers seemed to be the most active in their search for information. Face-to-face information was valued by many stakeholder groups, but the most important pre-requisite for information was that is should be provided by an impartial party or different viewpoints should be taken into account, in order to be trustworthy.

Keywords: Information needs, final disposal, radioactive waste management

This work has been performed within the OBRA project and co-funded by the European Commission (EC) as part of the sixth Euratom research and training Framework Programme (FP6) on nuclear energy (2002-2006).

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1 INTRODUCTION

Operating nuclear power plants have created radioactive waste, which needs to be handled in a way that it fulfils the needs of long-term governance. The most prominent solution at the moment is depositing radioactive waste in a deep geological repository. However, finding a suitable site and gaining acceptance for such a repository has turned out to be problematic in many countries.

There seems to be a common understanding among all involved parties that public participation is needed not only for siting, but all decisions for final disposal facilities of radioactive waste. However, there does not exist a strong common vision on the ways and means to achieve a fruitful dialogue between different stakeholder groups and how to involve different stakeholders into the decision making process. Because radioactive waste management is a complex and multi-faceted issue, the level of information different people possess has an impact on their abilities to engage in discussion. Thus, information that is (a) available before the decisions are made, (b) understandable, (c) credible, (d) consistent and (e) related to all issues of public interest, is a prerequisite for public dialogue (OECD/NEA 2003).

From this starting point, I will examine the information needs and preferred ways of access to information of specific stakeholder groups.

1.1 Background and rationale

Public acceptance is a crucial factor for nuclear waste management. Because the license for a final disposal facility requires a political decision in addition to a technical and regulatory decision, it requires broad public consent (OECD/NEA 2003). There have been setbacks in nuclear waste management programmes due to public opposition, for example in the UK, France, Germany and Switzerland (Andersson 2004). The European Commission's Euratom programme focuses on ensuring that information on radioactive waste is advertised and accessible in order to overcome fear and mistrust caused by lack of information and feeling of

powerlessness (EC 2004b). The developing opinion of European Union citizens on the subject of nuclear energy, and radioactive waste in particular, as well as the level of information and actual knowledge has been analysed and monitored in a series of special Eurobarometer studies (EC 1999, 2002, 2005).

For example in Finnish legislation, it is stated that construction of nuclear facilities, including the final disposal facility for spent nuclear fuel, has to be in accordance with *the overall good of the society* (The Nuclear Energy Act 1987). The governance process concerning the siting and licensing of nuclear facilities takes into consideration the many different stakeholder groups that participate in the decision-making process and public debate thus ensuring that the decisions are in line with *the overall good of the society*. Different stakeholder groups in nuclear waste management include national authorities, members of parliament, international organisations, NGOs, science and research institutes, nuclear waste management agencies, nuclear power plant operators, university students and professors, local communities, media etc. Below is one illustration of the stakeholders of Finnish radioactive waste management company Posiva.

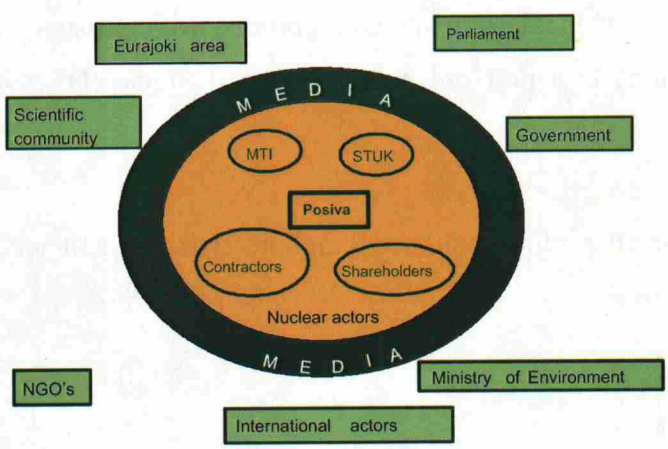

Figure 1. The principal stakeholders for the spent nuclear fuel repository in Finland (EC 2004a)

As a part of the Environmental Impact Assessment process, a number of environmental, social, psycho-social and economic effects of final disposal have been studied from national and local communities point of view (Posiva 1999).

General characteristics of good governance of hazardous activities have been studied in numerous studies. In the area of nuclear waste management, there is a need to develop a practical model in the European level for disseminating knowledge to all concerned stakeholders in order to meet the principles of good governance; openness, participation, accountability, freedom of information and expression, capacity building as well as coherence and effectiveness (OBRA 2007b).

1.2 OBRA-project

This research is part of the OBRA-project (*European observatory for long-term governance on radioactive waste management)*. OBRA is a two—year coordination action co-funded by the European Commission (EC) as part of the sixth Euratom research and training Framework Programme (FP6) on nuclear energy. OBRA aims to assess the feasibility of a European Observatory and to create a model for long-term governance on radioactive waste management. (OBRA 2007a)

Moreover, OBRA aims to contribute to the better governance of radioactive waste by providing mechanisms for all stakeholders to have access to the knowledge that has been generated by successive EU research programmes. The focus of the OBRA-project is on the siting phase of a final disposal facility. There are ten project partners from seven EU member countries. The project partners represent different stakeholder groups such as radioactive waste management implementers, authorities, research institutions, universities and municipalities. (OBRA 2007a)

1.3 Observatory for long-term governance on radioactive waste management in Europe

The aim of the OBRA-project is to assess the feasibility of an observatory for long-term governance on radioactive waste management in Europe. In this chapter, I will explain what such an observatory means.

The Oxford Dictionary (1995) defines the concept of an observatory as "*a special building from which the stars, the weather, etc. can be observed by scientists*". In addition to the usual meaning of observatory as a building, place or institution designed and equipped for making

observations of astronomical, meteorological, or other natural phenomena, there are several different types of observatories (Martell 2007). There are examples of different types of observatories focusing on independence, multi-disciplinary approach and involving different stakeholder groups into a common discussion, which have more in common with the observatory meant here than the traditional meaning of observatory (CEO 2007, International Social Observatory 2007, The Observatory of European SMEs 2007, European Observatory on Demography and the Social Situation 2007, etc.).

The concept or content of observatory in the OBRA-project is not yet clearly defined, but it refers to "*a platform of knowledge management, communication and research on governance of radioactive waste management*" (OBRA 2007c, p. 4). Central to the idea of a European Observatory for long-term governance on radioactive waste management is that it should promote appropriate forms of interaction between stakeholders, support a long-term collaborative partnership and combine multi-disciplinary knowledge. A suggested vision of the observatory is "*to become the central point of reference for knowledge acquisition in the decision making related to the siting process of the stakeholder groups, experts and the general public*" (OBRA 2007c, p.8).

The attribute *long-term* in the context of radioactive waste management refers to a time period greater than a few hundred years. The long-term management options considered at the moment are mainly land-based geological disposal with a few countries also considering indefinite storage as an option. Some options have been ruled out due to uncertainties, risks or being politically or social unacceptable (disposal into outer space/in ice sheets/in deep-sea sediments). The principles guiding the selection of the long-term management strategy are safety of future generations, preservation of the environment, the precautionary principle, intergenerational equity and sustainability (EC/Euratom 2004).

Governance refers to "*process whereby societies or organizations make important decisions, determine whom they involve and how they render account*" (IOG 2007). The discussions on governance of radioactive waste management will be revisited in more detail in Chapter 2.

Radioactive waste can be categorized for example as spent fuel (SF), high-level waste (HLW), intermediate-level waste (ILW) and low-level waste (LLW) (Posiva 2003, EC 2004a, 2004b). The hazard decreases over time by radioactive decay and the wastes which are

weakly decaying, are referred to as long-lived (EC 2004b). Most of the radioactive waste is from nuclear power production but certain types of radioactive waste can also be generated by research centres or hospitals. For example in Finland, Posiva's RTD program deals solely with spent nuclear fuel and nuclear power plant operators take care of the low and intermediate level nuclear waste (Posiva 2003). In this report, and the OBRA-project as a whole, radioactive waste refers to spent fuel and long-lived radioactive wastes.

1.4 Purpose of the research

This study aims to provide knowledge on the information needs and preferred ways of access to information of specific stakeholder groups and to give suggestions on how to create a pilot observatory for long-term governance of radioactive waste management in Europe. The purpose of this study is mainly descriptive in nature, because it aims at presenting precise descriptions on the nature of the information needs and also documenting the central and most interesting features of the phenomenon. The purpose of the research can also be regarded as surveying because the purpose is to find new viewpoints and try to find answers to questions that have not been studied before. (Hirsjärvi et al. 2007)

The specific stakeholder groups in this research include **the local communities in Finland and Sweden**, which have been considered as possible sites for a final disposal facility, as well as **students and professors in social and environmental sciences**. In Finland, the municipality of Eurajoki has been selected as the site for deep geological repository and in Swedish municipalities of Östhammar and Oskarshamn the site investigations are on-going. The groups have been divided into four subgroups:

- residents of local communities
- people participating in decision-making at the local level concerning the siting of the final disposal facility
- professors of social and environmental sciences in Sweden
- students of social and environmental sciences in Sweden

The research questions, which will be covered by the stakeholder groups specified above include:

- What are the practical information needs concerning radioactive waste management of the selected stakeholder groups?
- Which are the preferred ways of access to information on radioactive waste management or interaction among stakeholders?

Further research tasks are:

- to define approaches and means of accessing these stakeholder groups
- to define approaches and means of meeting their information needs
- to define approaches and means of forming a living contact interface with these stakeholder groups.

These research tasks will be carried out based on the empirical data and previous studies regarding the information needs and preferred ways of access.

1.5 Structure of the research

Chapter 1 in this paper provides a background to the research questions, introduces the main objectives for assessing the feasibility of European Observatory for long-term governance on radioactive waste management and thus justifies the rationale for this study. Chapter 2 outlines the theoretical and conceptual basis used in this study discussing governance of radioactive waste management, knowledge-based view and stakeholder theory. The main concepts used in this study will also be introduced. Chapter 3 begins with an introduction to governance processes for siting of a final disposal facility for high-level radioactive waste in Finland and Sweden in order to give a better understanding of the status of decision-making processes in these countries. After that, the previous relevant empirical studies concerning attitudes, information needs, and risk perceptions surrounding the issue of radioactive waste management will be reviewed. Research design and methodologies used in this study will be covered in the Chapter 4. Chapter 5 reviews the results of this study; the information needs of the local communities based on literature research and the information needs of students and professors in environmental and social sciences, based on interviews and questionnaires.

Finally, based on the results, a conclusion giving suggestions for a practical approach of a pilot observatory and also for future research is presented in Chapter 6.

2 THEORETICAL AND CONCEPTUAL CONTEXT

Several theories can be used to study the information needs of different groups and to build a proposition for an observatory for radioactive waste management. In this chapter, I will introduce the theoretical background and the concepts through which I will study the information needs of two specific groups (university professors and students; local communities), and which I will use later on as a basis for the practical approach for the pilot observatory. The basic questions analysed through the theories presented in this chapter are presented in the following table.

	Questions addressed in this study	Key concepts	Authors
Knowledge-based view	What are the practical information needs of different groups? Which are the preferred ways of access?	information, knowledge, data, information needs, information seeking, information use, information practices	Choo 1998; Choo & Bontis 2002 Davenport 1997 Dervin 1992 Kuhlthau 1993 Nonaka & Takeuchi 1995 Taylor 1991 McKenzie 2003
Stakeholder theory	How the different stakeholder groups are influencing others?	stakeholder, legitimacy, stakeholder network, acceptability of operations	Freeman 1984 Donaldson & Preston 1995 Phillips 2003
Governance of radioactive waste management	How could the principles of good governance be applied to the observatory?	good governance, transparency, participation, risk-informed decision-making	Öko-Institut 2007 Several EU research programmes

Table 1. Theories, questions, key concepts and authors

2.1 Governance

The first part of this chapter defines the concept of governance. The scientific discussions on risk communication as well as main results from related EU projects dealing with formal and informal participatory processes in the context of potentially hazardous and publicly disputed issues will be covered in order to provide an overview of governance of radioactive waste management.

The socio-scientific background of governance on radioactive waste management and elements of successful governance processes to be used as a basis to defining a set of features

for an Observatory for Long-term Governance of Radioactive Waste Management were presented in an OBRA project background document (OBRA 2007b). According to definitions cited in the report, governance can be understood as a "*process whereby societies or organizations make important decisions, determine whom they involve and how they render account*" (IoG 2007) or as "*a neutral concept comprising the complex mechanisms, processes, relationships and institutions through which citizens and groups articulate their interests, exercise their rights and obligations and mediate their differences*" (UNPD 2007). Governance system or framework, in which the process of governance lies, consists of both formal (e.g. constitutions or policies defining how the process is supposed to function) and informal (e.g. traditions, accepted practices, or unwritten codes of conduct) elements. Principles of good governance chosen as a framework include legitimacy and voice, direction and strategic vision, performance evaluation, accountability, sufficient resources and fairness (OBRA 2007b).

After an analysis of different approaches to governance, the report arrives at the following core activities of good governance at the regional level:

- institutionalised regional cooperation with an iterative participatory goal formulation
- participatory knowledge acquisition and capacity building
- continuous exchange and communication with the involved actors' network as well as with the local and regional media. (OBRA 2007c)

Even though the focus of the OBRA project is mainly on the regional level, the governance process at the national level has to be taken into account as well.

The aspects related to governance of radioactive waste management have been covered in a number of recent and on-going EU projects. Providing mechanisms for all stakeholders to access the knowledge (both published documents and experience of experts) generated by successive EU research programmes is of interest to the OBRA-project.

TRUSTNET-projects (TRUSTNET, TRUSTNET2, TRUSTNET IN ACTION) have focused on risk governance as well as governance arrangements and practice for hazardous activities and their impact on public health and the environment. "Mutual Trust Paradigm" and processes of change towards inclusive governance have been created and tested within these projects. COWAM and COWAM 2 have approached stakeholder involvement at the local level on radioactive waste management with a focus on community needs and practical

solutions. The continuation of these projects is COWAM IN PRACTICE (CIP), which will develop guidelines for inclusive governance based on the analysis of five radioactive waste governance processes at national level in five different countries. RISCOM model of transparency has been created in RISCOM II, a project dealing with transparency and participation in decision-making processes (Andersson & Wene 2006). RISKGOV has looked into the elements contributing to the quality of governance systems.
CETRAD was a project focusing on education and training needs in radiological protection and radioactive waste management. (OBRA 2007b)

The discussions on transparency and participation as well as risk-informed decision-making are closely related to governance of radioactive waste management. Transparency in this context means that the decision-makers and the public are able to validate claims of truth, legitimacy and authenticity (Andersson et al. 2005). There seems to be a common understanding that radioactive waste management programmes need to become more communicative and not rely on disseminating one-way information.

2.2 Knowledge-based view

For studying the information needs of different groups chosen for this research, I have looked into the literature on the knowledge-based view of strategy management. From this perspective and based on earlier information needs and uses studies, I gained a framework for analysing the three stages of information use, namely information needs, information seeking and information use. The complexity of the field of nuclear waste management involves many different stakeholder groups with differing needs for information and also the affective responses related to the nuclear industry as a whole can be addressed by analysing the information needs in terms of their cognitive, affective and situational elements.

Knowledge management refers to a range of different approaches studying how information is created, identified, shared and transferred. There are several schools of thought within the knowledge management field, which have a slightly different perspective on the issue depending on their focus (technologies, information studies, organizational knowledge creation, innovations, strategic aspects, applications for learning, intellectual capital management etc.) (Choo & Bontis 2002).

2.2.1 Data, Information and Knowledge

I will start by examining the differences between the concepts of data, information and knowledge. The following figure illustrates the different levels in conceptual hierarchy and the enrichment processes – the moves between different levels demonstrating its application to the currency market as an example.

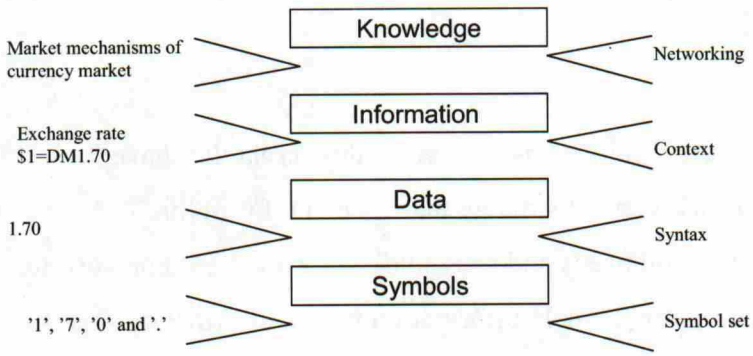

Figure 2. Relationships between levels in conceptual hierarchy (from Rehäuse & Kremar 1996 in Probst et al. 2002)

The basic level of symbols, for example letters or numbers, became data when rules of syntax are applied to them. *Data* in itself does not carry a meaning but is capable of interpretation within a particular context (Probst et al. 2002). According to Davenport (1997), data is "observations of states of the world" whereas *information* requires some level of analysis. Data becomes *information* when it is applied to a context (Probst et al. 2002). Choo (1998) emphasizes the nature of information as fabricated by individuals as he talks about information as often having a physical manifestation (document, record etc.), but the context and meaning of the information is created each time it is taken up by a user. According to Probst et al. (2002) information becomes *knowledge* when it is networked and can be used in a particular field or activity. Another way of looking at knowledge is to regard it as information with the most value because of the context and meaning given to it (Davenport 1997). Probst, Raub and Romhardt (2002) define knowledge as "the whole body of cognitions and skills which individuals use to solve problems". They see knowledge including both theoretical and practical aspects and being based on data and information. According to Probst et al (2002), knowledge is always bound to persons; it is constructed by individuals and represents their beliefs. Sometimes additional levels such as wisdom, intelligence and ability to reflect can be used. (ibid.)

Another way of illustrating knowledge and its "raw materials" is using the data/knowledge continuum. The distinction of these is difficult to make in practice. (Davenport 1997, Probst et al 2002)

Data	**Information**	**Knowledge**
Simple observations of states of the world • Easily structured • Easily captured on machines • Often quantified • Easily transferred	Data endowed with relevance and purpose • Requires unit of analysis • Need consensus on meaning • Human mediation necessary	Valuable information from the human mind Includes reflection, synthesis, context • Hard to structure • Difficult to capture on machines • Often tacit • Hard to transfer

Table 2. Data, information, and knowledge (Davenport 1997)

Information sources can be classified by degree of documentation as formal or informal, by the place the information is produced as internal or external, or by originality as primary, secondary or tertiary. Usually an information source is understood as a document, which can be either printed (e.g. books, magazines) or electronic (e.g. www-pages, tv news). Also human beings, for example colleagues, can be seen as information sources. (Haasio & Savolainen 2004)

Channel refers to an organised process or mechanism, by which it is possible to reach information sources. A library is a typical example of an organised mechanism, which offers a systematic access to various information sources. Also a person can act as a channel. (Haasio & Savolainen 2004)

2.2.2 Information Needs and Uses

Even though knowledge management focuses primarily on organisational level, the core of information behavior analysis is understanding how individuals handle information (Davenport 1997). In this work I have concentrated on the knowledge-based view of strategy management and especially on questions of information needs and uses aiming to understand the personal, organisational and social situation in which the information need arose and in which the acquired information will be put to use. I will present a framework which is user-centered and integrative in approach, and in which information is seen as subjective, residing

in the user's mind and being useful only when meaning has been created by user. (Choo 1998)

Choo (1998) presents a general model of information use that attempts to identify and relate the major elements influencing the behavior of the individual when seeking and using information. The model consists of three stages and within each stage, the effects of the individual's cognitive needs, affective responses, and situational demands. As a starting position for this approach, it is assumed that the information user is a cognitive person, information is constructed in the thoughts and feelings of users, information seeking and use is a dynamic process extending over time and space and the use and usefulness of information is determined by the context of information use. The model is based on earlier work of Brenda Dervin (1992), Carol Kuhlthau (1993) and Robert Taylor (1991).

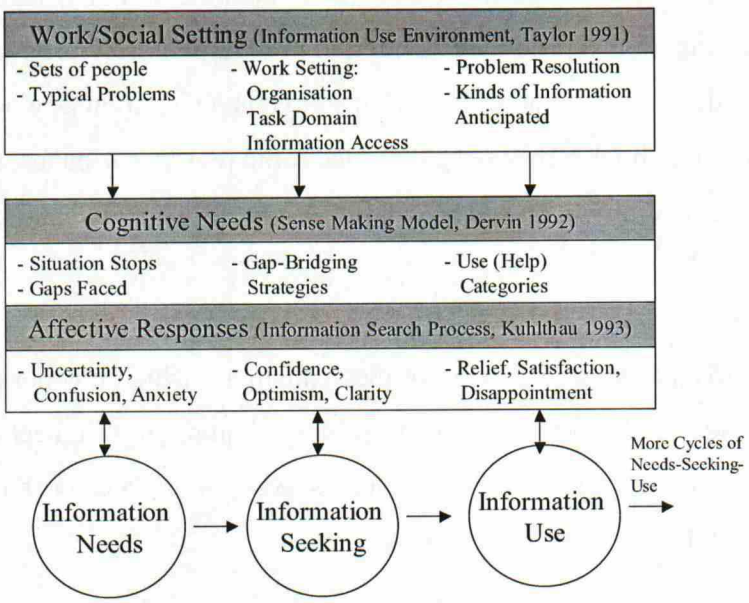

Figure 3: General Model of Information Use (Choo 1998)

Cognitive needs in the general model of information use are based on the sense making approach which compares information needs with gap perceptions, information seeking with gap-bridging strategies and information use with the help in crossing the gap. Sense making approach tries to answer to the question of how the individual defines a gap situation and attempts to bridge the cognitive gap. *Situation stops* refer to a set of categories describing the ways in which individual sees the way ahead being blocked. Examples of situation stops include decision stop (where one sees two or more roads ahead) and barrier stop (where one sees one road ahead but something or someone stands on the road blocking the way). *Gap-*

bridging strategies include the timing and location of events, understanding causes, projecting outcomes and identifying characteristics of self, others, events and objects. *Help categories* capture how people put the information obtained to use. Help categories relate to particular situation in a way that for example creating ideas corresponds to decision stop and finding directions to barrier stop. (Choo 1998, Dervin 1992)

Affective responses to information seeking hold that uncertainty is experienced both as a cognitive state and as an affective response and it rises and falls as the search process progresses. According to information search process feelings of uncertainty are common to the initiation stage when one recognizes a need for information. As the process continues the feelings characteristic to each stage change from optimism, clarity, sense of direction to relief with the feelings of confusion, frustration and doubt being predominant feelings during the stage of exploration when individual investigates information on general topic. (Choo 1998, Kuhlthau 1993, 2005)

Situational dimensions of work and social settings are studied using the notion of information use environments (IUEs) presented by Taylor. *Sets of people* are groups categorized by profession, entrepreneurs, special interest groups and special socio-economic groups, who share assumptions and attitudes about the nature of their information behavior. *Typical problems* or problem dimensions serve as criteria by which the relevance of information to a problem will be measured. There are eleven dimensions positioning problems on a continuum of for example design/discovery, well-structured/ill-structured, simple/complex or goals specified/goals amorphous. These dimensions represent the information use environment surrounding problem situations. *Work settings* refer to the social and physical attributes of the organisation that influence attitudes toward information, the types and structures of information required as well as the flow and availability of information. Shared perceptions of resolutions to typical problems which guide the information seeking and use are called *problem resolution assumptions*. These assumptions and *anticipations* control indirectly the breadth and depth of information by influencing the time and effort spent on information searching, sources where to look for information, ways to filter the information encountered and the kinds of information required. (Choo 1998, Taylor 1991)

The first stage in the general model of information use, *information needs*, are seen to emerge through multiple levels as described earlier. This means that meeting information needs

requires more than merely providing information that matches the subject matter in one's question. We should also bear in mind that information needs do not emerge fully formed but grow and evolve over time. Even a perceived information need does not always lead to seeking information. Different definitions of the concept of "information need" have been presented within information sciences. The difficulty arises from separating the concept from "wants", "expressed demand", "satisfied demand" and so on (Haasio & Savolainen 2004, Wilson 1981). Another source of confusion is created by interrelations between different categories of human needs; physiological needs (such as the need for food, water, shelter, etc.), affective needs (such as need for attainment, for domination etc.) and cognitive needs (such as the need to plan, to learn a skill, etc.). Wilson (1981) claims that as part of the search for satisfaction of these needs, an individual may engage in information-seeking behavior and therefore we should speak about "information seeking towards the satisfaction of needs" instead of "information needs".

The second stage, *information seeking*, refers to purposefully searching for information in order to change the state of knowledge. By one generic categorization, the information-seeking activities can be divided in the following categories: starting, chaining, browsing, differentiating, monitoring, extracting, verifying and ending. (Choo 1998) Information seeking is normally seen as action resulted by a need for information in order to identify the relevant information sources and channels, to find one's way to these sources and to choose from different sources and channels to satisfy the information needs. Sometimes information can be obtained in a situation that cannot be foreseen in advance, when the term accidental information seeking or incidental information seeking has been used (Haasio & Savolainen 2004). A good illustration of information practices ranging from actively seeking out a known source or planning a questioning strategy, to serendipitously being contacted by a previously unknown source or being given unasked-for advice is the following two-dimensional model of the information practices (McKenzie 2003).

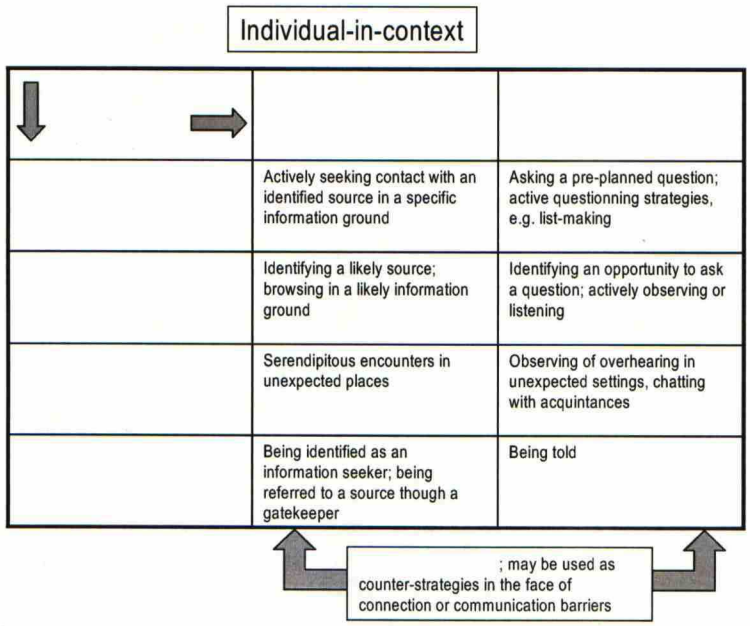

Figure 4. Two-dimensional model of the information practices described by participants (McKenzie 2003)

McKenzie (2003) identifies the following modes;

- active seeking (most directed mode of information practice),
- active scanning (recognition of a particular location as a likely information ground, or a particular source as likely to be helpful, although the seeker may not describe having an expectation of finding anything specific),
- non-directed monitoring (serendipitously encountering and recognizing a source in an unlikely place, while not seeking information at all or while monitoring information sources)
- by proxy (participants making contact with or interacting with information sources though the initiative of another agent, either the information source or some other gatekeeper or intermediary).

Choo (1998) cites Taylor to define the final stage of the model, *information use*, as *"the individual making a choice or selection of messages from a larger pool of messages to attend to or to act on"*. The perceived relevance of the information is found to be a good predictor of the information use. Relevance of the information is assumed to be subjective, cognitive, situational, multidimensional, dynamic, yet measurable (Choo 1998, Taylor 1991). Dervin

and Nilan (1986) propose the following actions in order to create a user-oriented information system:

- Treating documents in various ways to make the system more meaningful to users
- Devising new indexes based on user-relevant criteria to supplement subject-oriented indexes
- Including emotionally oriented indexes that address emotional dimensions of experience among the ways to access materials
- Changing the procedures by which user needs are assessed in practice, from keyword, symbol-matching, and subject orientations to user-problematic situations
- Presenting information in whatever form the end user requires.

2.2.3 Knowledge Creation

In order to move from individual level to the level of organisations as knowledge-creating enterprises, the key concepts of tacit and explicit knowledge have to be introduced. Because knowledge in organisations is widely dispersed to its members, the mechanisms of how knowledge can be transferred from one individual, department or company to another have to be understood. *Tacit knowledge* refers to knowledge that is highly personal, subjective and intuitive by nature and hard to formalize, and thus difficult to share with others. Tacit knowledge is not easily visible, not even to the individuals themselves, because the knowledge is deeply rooted in actions, experiences and values. For tacit knowledge to be shared with others, it has to be converted into words or numbers. *Explicit knowledge* on the other hand is codified knowledge, which is readily transferable via formal communications or mechanics. (Nonaka & Takeuchi 1995)

Ikujiro Nonaka and Hirotaka Takeuchi focus on tacit knowledge and its interaction with explicit knowledge in the creation of innovations on their often-cited work *The Knowledge-Creating Company* (1995). According to Nonaka and Takeuchi, there are four modes of knowledge conversion: from tacit to tacit (called socialization), form tacit to explicit (externalisation), from explicit to explicit (combination), and from explicit to tacit (internalization).

According to Probst (2002) the core processes of knowledge management are knowledge identification, knowledge acquisition, knowledge development, knowledge

sharing/distribution, knowledge utilization and knowledge retention. Davenport criticizes the predominant role of the information technology in some of the knowledge management literature and practices, and in turn emphasizes a more holistic understanding about how people create, distribute, understand, and use information. In doing this Davenport borrows a concept from natural sciences and talks about Information Ecology. The key attributes in information ecology include integration of diverse types of information, recognition of evolutionary change, emphasis on observation and description, and focus on people and their information behavior. (Davenport 1997)

2.3 Stakeholder theory

In this chaper, I will introduce the relevant concepts of stakeholder theory to serve as a basis for understanding the complex stakeholder networks in radioactive waste management field. In the countries studied in this research, Finland and Sweden, the entities bearing responsibility for radioactive waste management (the nuclear power plant operators) and the ones implementing final disposal (the radioactive waste management agencies) operate as industrial non-profit companies[1], and not as government agencies like in some European countries. These companies are often the ones taking a major role in the communication on radioactive waste management. This is why I have also reviewed theories from management, namely stakeholder theory, to give insight into how the management of these companies reflect to the other stakeholder groups.

Stakeholder theory has usually been applied to companies but since the focus of this research is on creating a European Observatory for long-term governance of radioactive waste management, in this case the observatory is thought to be a "company", a central element of a stakeholder network.

Freeman (1984) defined *stakeholder* as any group or individual who can affect or be affected by the achievement of a corporation's mission. According to Freeman, the characteristics of an organisation with high stakeholder management capabilities include for example negotiating explicitly with stakeholders on critical issues and seeking voluntary agreements, integrating boundary spanners into the strategy formulation processes in the organisation and being proactive in anticipating stakeholder concerns and trying to influence the stakeholder environment.

[1] Posiva Oy in Finland and SKB in Sweden are non-profit companies owned by the nuclear power plant operators taking care of the implementation of the radioactive waste management

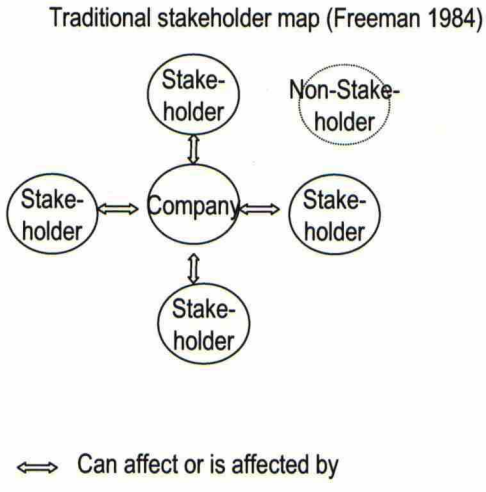

Figure 5. Traditional stakeholder map (Freeman 1984)

Stakeholder theory has been critized for example for its loose theoretical status and lack of criteria for stakeholder identification (Donaldson and Preston 1995, Mitchell et al. 1997). Many authors have contributed to the development of stakeholder theory and clarified its theoretical status. Donaldson and Preston (1995) introduced *descriptive* (how the world really is), *normative* (how the world should be) and *instrumental* (connections between stakeholder management and corporate objectives) parts into stakeholder theory. They also claim that for a company to pursue a strategy of corporate social responsibility it has to identify the object of their responsible actions and that object is most commonly the stakeholders. Through this link the stakeholder approach is also linked to corporate social responsibility.

Phillips (2003) introduced the concepts of normative and derivative legitimacy into stakeholder management. A company has a moral obligation (a stakeholder fairness obligation) towards a *normative stakeholder* whereas the *derivative stakeholders* are groups whose actions and claims may pose potential effects upon the normative stakeholders. Due to the notions of normative and derivative legitimacy, some stakeholder groups merit more consideration from the management than others. Phillips also thought that the stakeholder relationships could better be depicted as a network rather than the traditional stakeholder map. The stakeholder network takes into account the more complex operating environment of the company and the various direct and indirect relationships with the stakeholders as well as the relationships of the stakeholders with each other. Some of these relationships may be conflicting with each other.

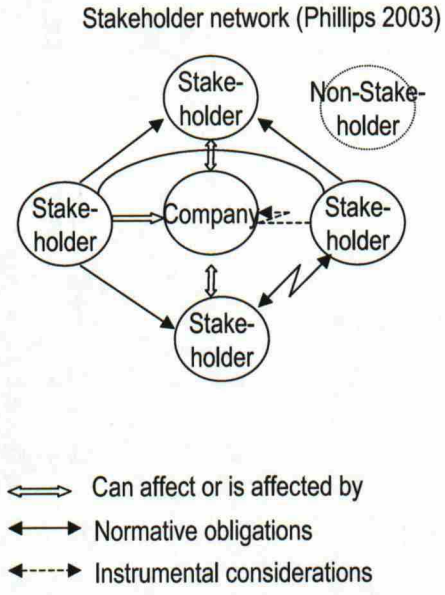

Figure 6. Stakeholder network (Phillips 2003)

According to Lovio (2004), there are three approaches to stakeholder theory. The first suggests that a company should pay equal consideration to claims made by stakeholders, proportioned with the inputs of stakeholders and the importance of the issues. The second viewpoint states that the company's performance in the long run is determined by its ability to take its stakeholders' claims into consideration. The last approach stresses that the operations of a company can be best described and explained through its interaction with its stakeholders.

3 RELEVANT EMPIRICAL STUDIES ON SITING A FINAL DISPOSAL FACILITY FOR HIGH-LEVEL RADIOACTIVE WASTE

Social science research on nuclear waste management has been extensive, but studies purely on information needs concerning radioactive waste management are few.

I will start this chapter with a general overview of the governance processes in Finland and Sweden concerning the siting of the final disposal facility for high-level radioactive waste. The siting of nuclear waste facilities has not succeeded without difficulties in all countries. Recent experience in Finland and Sweden indicate, however, that it may be possible, under certain circumstances, to gain local acceptance for the siting of a final disposal facility for high-level nuclear waste (Sjöberg 2004). This chapter presents on overview of the siting processes for a final disposal facility in Finland and Sweden. Firstly, I will introduce the governance process in Finland with a focus on environmental impact assessment. Different opinions on the key success factors as well as critical voices on the governance process will be evaluated. Then, I will move on to the governance process and the current status of siting of the final disposal facility in Sweden. Because the siting processes in both countries have included vast information actions, understanding the status and the activities done during the siting process are crucial for understanding the information needs for this study. Internationally Finland and Sweden have been pointed out as nations unlike others because they have already succeeded in achieving relatively high degree of success in practical tasks of radioactive waste management (OECD/NEA 2002, McCombie & Tveiten 2004, Elam & Sundqvist 2006). Even though the situation in these nations differs from other countries, I feel that there can be lessons-learnt for others.

The early social science studies on radioactive waste management from the beginning of the 1980s deal mainly with the social and policy issues of radioactive waste management in the U.S. (e.g. Walker et al., 1983) and contributions in the 1990s shed light on attitudes, perceived risk, trust and politics surrounding nuclear waste (e.g. Dunlap et al. 1993, Slovic et al 1991). There are a lot of more recent publications on the European situation funded by the European Commission under specific Euratom research programmes on nuclear energy. A lot of the research, especially in Finland and Sweden, has been conducted by various researchers

and research institutes, but funded by the nuclear power companies or radioactive waste management agencies (Posiva and SKB) to serve a practical purpose as part of the environmental impact assessment (EIA) processes. National authorities have also commissioned their own studies (e.g. Hautakangas 1997). For example in Sweden, the local communities were granted money to order their own research reports on subjects they needed. In Finland, social scientific studies on radioactive waste management has been carried out within a publicly funded radioactive waste management research programmes (JYT-tutkimus) by such research institutes as Universities of Jyväskylä and Tampere and VTT (Litmanen & Kaunismaa 1999).

Because most of the research surrounding radioactive waste management mentions information, information needs and information sources, but is more focused on some other research aim, I will present the relevant studies on attitudes, information needs and risk perceptions concerning radioactive waste management.

3.1 Governance process in Finland for siting the final disposal facility

The governance process on radioactive waste management in Finland involves multiple stakeholders and decisions made both at the local and national levels. In this chapter, I will examine how the political and societal decision on siting of the final disposal facility has come about, focusing on stakeholder involvement especially during the Environmental Impact Assessment (EIA) process. Hokkanen (2008) describes EIA as a process of identifying and evaluating potential impacts from proposed activities while being an interactive and communicative policy instrument, which should facilitate direct participation.

The stepwise decision-making process towards the disposal of spent nuclear fuel was started almost 20 years before the Decision in Principle (DiP) was made in 2001, selecting Eurajoki as the site for the final disposal facility. Even before that, during 1970s, the nuclear power plant operators started studying nuclear waste management issues. The first major step in the process was a government Decision in Principle in 1983 specifying the aims and the overall schedule for final disposal. Site investigations were started in five municipalities by Teollisuuden Voima, the operator of nuclear power plant in Eurajoki. In 1994, there was an Amendment to the Nuclear Energy Act banning the export and import of nuclear waste. As a

result, site investigations were started in the other Finnish municipality with a nuclear power plant, Loviisa, because earlier it was allowed for the Loviisa power plant to export the waste to Russia. In 1995, Posiva Oy was established by two Finnish nuclear energy companies as the implementer for final disposal.

Posiva started an Environmental impact assessment (EIA) programme for the final disposal facility for spent nuclear fuel in 1997. The programme includes a plan for the EIA studies to be made to ascertain and assess the various environmental impacts involved. The Environmental Impact Assessment Report was published in 1999 and an environmental impact follow-up programme was set up, based on the report. The EIA report covers such areas as impact on nature, land use and cultural heritage, human health and social impacts. [2] The EIA includes an assessment of a "zero alternative", i.e. non-implementation of final disposition. The main issues when comparing the zero alternative (continuing storage in water pools) with the final disposal alternative include passing the obligation for supervision and maintenance to future generations, not being protected against the long-terms risks and taking the risk of deepening the conflicts due to postponing the decisions. (Posiva 1999)

During the EIA process, there was local level interaction between the implementer (Posiva), local residents, entrepreneurs, politicians, officials of the municipal council and members of NGOs, which brought about discussion on the advantages and disadvantages of alternative nuclear waste management strategies. The Ministry of Trade and Industry organised public hearings, which highlighted the need to discuss different alternatives. The Radiation and Nuclear Safety Authority organised some meetings. Posiva also organised own public and focus group information meetings to inform, to gather information and to discuss and negotiate with different stakeholders. This interaction has been characterized as a major break-through, but some researchers and opposing groups were more critical of the success of the EIA (OECD/NEA 2002, OECD/NEA 2003). According to Kojo (2005), the approach to stakeholder involvement in the siting process in Finland has changed several times. In the first test drillings, only the permission of the landowner was needed. Negotiations with the local authorities were started in 1986 and, in the next year, the focus was shifted to remedy the

- [2] impact on nature (air, water, organic nature, ground and climate) and utilisation of natural resources,
- impact on land use, cultural heritage, the landscape, buildings and the urban image
- effects on human health (health effects caused by impurities, noise and vibration; traffic accidents; health effects of radioation; psychosocial effects)
- social impacts (effects on community structure, effects on living conditions and general well-being)

knowledge deficit of the local public. Kojo characterizes the stakeholder involvement a few years prior to the EIA as engaging in two-way communication with the local people by means of debate in local newspapers and an information leaflet, with EIA becoming an interaction forum in 1996-1999.

Finally, the Decision in Principle was made by the government in 2000 and ratified by Parliament in 2001, based on siting the final disposal facility for spent nuclear fuel in Eurajoki. Before the government could make the decision in principle, there was a requirement that the Municipality of Eurajoki provide a supporting statement. Before the DiP, the Radiation and Nuclear Safety Authority (STUK) also submitted their safety review. Separate decisions are still required for obtaining a construction and operating licences for final disposal facility. (OECD/NEA 2002, OECD/NEA 2003, Posiva 1999)

3.2 Governance process in Sweden for siting the final disposal facility

In Sweden, the site for a final disposal facility for high-level nuclear waste has not yet been decided even though the siting process has been going on for about 20 years. The legal obligation for finding a site for spent nuclear fuel has been given to Swedish Nuclear Fuel & Waste Management Co. (SKB), which is owned by the Swedish nuclear power companies. SKB can conduct feasibility studies and site investigations without the permission from government or municipality, but licencing is required under law for a detailed investigation at a particular site. In practice, the concerned municipalities have given their consent in form of approval by the local council to feasibility studies and site investigations. It has been SKB's policy to find a voluntary host community, because like in Finland, an application for a siting permit must not be granted by the national government unless the local council has given its approval. In addition to consent from the municipality, the conditions for a repository have to be physically and socially adequate and safety has to be assured. (Sjöberg 2004)

The first phase in the siting process in Sweden involved a feasibility study. A policy decision from the municipality was needed to move to the next phase, a site investigation, involving comprehensive geo-scientific investigations with the aid, among other things, of measurements from the ground surface and in drill holes. Local referenda in Storuman and

Malå in northern Sweden returned a negative response to proposed continued investigation and before 2001, no community had given its approval to a site investigation. In 2000 SKB selected six municipalities with potentially suitable sites (Hultsfred, Nyköping, Oskarshamn, Tierp, Älvkarleby and Östhammar), in November 2001, the Swedish government gave an approval to SKB's proposals and the work continued with the assessment of environmental impacts. Further studies were proposed in four sites (Nyköping, Oskarshamn, Tierp and Östhammar) based on previous overview studies, but later two municipalities (Nyköping and Tierp) declined further participation. As in Finland, the final candidate sites were already hosts of nuclear industry; Östhammar hosting the Forsmark nuclear power plant and also the repository for low and medium-level radioactive waste, SFR, and Oskarshamn hosting a nuclear power plant and the centralised interim storage for spent nuclear fuel, CLAB. (Sjöberg 2004)

In Sweden, nuclear waste management was one of the main topics nationwide during the national referendum on the future of nuclear power in late 70s and early 80s. Many people participated actively in public discussions and study circles and no question seemed to be too technical for laypeople to discuss. According to Elam & Sundqvist (2006) there has been a shifts in focus of discussion from (i) national or international level more to the local level, (ii) treating nuclear waste management as part of the overall future of the Swedish nuclear industry towards treating it as a separate question and (iii) handling radioactive waste management as scientific-technical challenge towards handling it as a socio-political challenge. They see local radioactive waste management projects, CLAB in Oskarshamn and SFR in Östhammar, as important events, which turned the discussion more from a national project into a local level decision-making. SKB's new siting strategy after what Elam & Sundqvist (2006) call a "test-drilling disaster" emphasised contacts with municipalities and presented siting as much more than just geological assessments. (Elam & Sundqvist 2006)

The issues most emphasized in the Swedish media have shifted from being mainly technical and economical in the beginning of the feasibility studies, to also include ethical, emotional and environmental perspectives (Nylander & Ahlqvist 2003). A government decision in Sweden allowed concerned municipalities to apply for funds to compile and distribute information to citizens and carry out review work by independent researchers and also reference groups were formed within the municipalities to follow, review and inform the citizens as publicly as possible.

3.3 Attitudes towards radioactive waste management

In this chapter, I will present the studies from different countries focusing on attitudes towards radioactive waste management. Attitudes play a major role in decision-making in controversial issues, and therefore it is important to study also the attitudes as well as the cognitive information needs.

The European Union has carried out three special Eurobarometer surveys, which analyze the opinion and level of knowledge of European Union citizens on nuclear energy, and radioactive waste in particular. The relevant results of the Eurobarometer study conducted in 2005 will be presented here with some comparisons to the earlier studies. The survey in 2005 was carried out by TNS Opinion & Social. Nearly 25 000 citizens in the 25 Member States of the European Union were interviewed for this study using a questionnaire, which has been adapted from the previous surveys. 37% of all respondents were in favour and 55% against energy produced by nuclear power stations. Resolving the issue of nuclear waste would change the opinion of as many as 38 % of those against nuclear power, at the European level. In some countries (Belgium, the Netherlands, Sweden, Lithuania, Malta, France, the United Kingdom) the radioactive waste issue seems to be a major factor influencing opinions on nuclear energy, because more than half of the opponents reported that they are prepared to change their opinion on nuclear energy if the issue of radioactive waste were to be solved. The main concerns if a deep underground disposal facility were to be built close to respondents' homes were the possible effects on the environment and health (53%) and the risks of radioactive leaks while the site is in operation (28%). Other concerns include transport of waste to the disposal site (7%), the risks due to a terrorist attack (4%) and a major drop in local property prices (3%). (EC 2005)

There were considerable differences in the answers given by different nationalities, but since the OBRA-project concerns a European observatory, this is a good overview of the opinions and level of knowledge on a European level.

Finnish energy industries have studied public opinion on energy related questions in a follow-up study since 1983. 1163 people were studied for this survey. 297 of the respondents were

inhabitants of Eurajoki or Loviisa, the two Finnish municipalities with nuclear power plants. The latest study from 2006 shows that less than one in three (30%) consider disposal of nuclear waste in the Finnish bedrock as being safe and almost half (47%) are sceptical. During the last 10 years the attitudes towards the use and further construction of nuclear power have shifted a more positive direction, but the attitudes towards nuclear waste have remained quite stable. According to the study, the reservations are partly explained by the fact that two thirds (68%) consider nuclear waste to be a continuous threat to the life of future generations and only 16% disagree. In communities with existing nuclear power plants, the attitudes towards nuclear waste are, on average, less negative than nationwide. The study suggests that confidence in safe disposal is significantly more widespread in communities with nuclear power plants. (Finnish energy industries 2006)

Kurki (1995) has studied information receiving and seeking behaviour in three Finnish municipalities (Eurajoki, Kuhmo and Äänekoski) that were candidates for the siting of the final disposal facility. There were significant differences between the three municipalities, with Eurajoki – a municipality with a nuclear power plant – having the most positive views on radioactive waste management and Kuhmo – the municipality having the strongest environmental, anti-nuclear pressure groups – being the most critical. According to a municipal image study conducted in 2006, 27% of residents in Eurajoki have a negative and 42% positive attitude towards final disposal. Men were more positive than women and 35-55-year-olds more critical than other age groups. (Corporate Image 2007) One of the earliest cases in Storuman showed that 55% of the voters had decided how to vote when they first heard about the issue and only 30% of the voters changed their minds during the study, which according to SKB study showed that attitudes were based on emotions (Elam & Sundqvist 2006).

Temo (SKB 2007) has studied Swedish people, and residents of Oskarshamn and Östhammar in particular, on their attitudes towards radioactive waste management. The study has been financed by SKB. Over 1300 people were interviewed for the research. The interviewees were asked which of the two statements was closer to what they think: "*If the solutions that can be developed with the technology and skills we have today fulfil the authorities safety criteria, I think that our generation should solve the issue of long-term storage of spent nuclear fuel.*" or " *If we wait before solving the issue of long-term storage of spent nuclear fuel, we could gain more information and technology. Therefore I think we should let the future generations to*

decide the long-term storage question." Over 80% of all respondents, both nationwide and in Östhammar and Oskarshamn, thought that our generation should solve the issue, and only 16% of all interviewed thought that we should leave the question to future generations to decide. The figure was even lower in Östhammar and Oskarshamn. It has to be noted though, that the statements talked about long-term storage, not final disposal. In a study conducted in Finland, a different wording was used to find out to investigate the same kind of question. In Finland, 23% are in favour of direct disposal while more than two out of five (45%) accept the notion that it would be better to keep nuclear waste in its present intermediate storage and wait for new solutions rather than to definitively deposit it in the bedrock (Finnish energy industries 2006). In SKB's study, 83% of interviewed (91% in Oskarshamn, 93% in Östhammar) thought that the spent nuclear fuel from Swedish nuclear power plants should be stored in Sweden and only 8% (4% in both Oskarshamn and Östhammar) though it should be sent to another country for storage. (SKB 2007)

3.4 Information needs

Relevant studies on the information needs on radioactive waste management will be presented in this chapter. In this case, the focus was limited to two countries, Finland and Sweden, which have quite many similarities in their nuclear waste management programs and therefore the information needs can be examined at the same time.

An average of 25% (22% in 1999 (EC 1999)) of the respondents to the Eurobarometer studies claim to be well informed about radioactive waste. The citizens of Sweden (51%), Slovenia (46%) and Finland (43%) seem to be best informed, whereas in Poland, Cyprus, Austria, Greece, Italy, Spain and Portugal less than one citizen in five felt well informed about radioactive waste. The actual knowledge regarding radioactive waste and radioactive waste management was studied using statements on the extent of danger, quantity, different types and sources of radioactive waste, and also the usage of different radioactive waste management methods. On radioactive waste, an average of 53% gave the right answer, 29% picked the wrong answer and 18% did not know. On the statements regarding radioactive waste management, 44% gave the right answer, 35% answered incorrectly and the "don't know" rate was 22%. (EC 2005)

According to Energy attitudes study (Finnish energy industries 2006) 44% think that there is a sufficient amount of energy information available whereas 33% disagree. Both figures show a slight decrease from previous years in confidence on the availability of correct energy information. During the first phase of the follow-up in 1996-2000, which coincides with the EIA process, the confidence has increased gradually.

Corporate Image conducted a municipal image study in 2006 (Corporate Image 2007) as a follow-up to an earlier study in 1998 to compare the external image of Eurajoki among the residents of the municipality, among Finnish consumers, and among representatives of businesses. 200 inhabitants in Eurajoki were interviewed for the research by telephone. The study was financed by Posiva. The study shows that residents of Eurajoki estimated the influence of final disposal clearly more favourable than consumers elsewhere in Finland. In the same study, the respondents were asked to which areas they would like to receive more information concerning final disposal. Whereas some interviewees thought that Posiva has already informed too much about its program, more interviewees wanted to have more information. General comments on information needs presented by individual interviewees include requesting "specifications to all topics" and at the other end of the spectrum "general information in layman terms for ordinary people". One interviewee would like to receive printed information material delivered at home address.

The specific areas mentioned in the interviews include:

- radioactive waste (what is radioactive waste?; radioactivity and isotopes)
- waste sources (is waste going to be imported to Finland?)
- updates on what is going on in radioactive waste management in Finland and in other countries (different approaches; what is currently being done; what, when and where etc.)
- long-term effects (effects to grand-children and grand-grand-children)
- site selection (why has Eurajoki been selected)
- technology
- waste disposal in practice and the risks involved (how are deep wastes buried? how long does it take until the waste has vanished?)
- safety (is final disposal safe for sure?)
- effects to environment
- long-term storage
- provisions for costs of final disposal.

Some interviewed local residents feel that the information disseminated by Posiva has been given an unrealistically positive picture about final disposal and is therefore not credible. Below are some critical quotes from the research (translated from Finnish to English):

> *"In my opinion, communication on final disposal has been glib, and much more information on it is needed. There should also be more research, because it is a new proposition in the world, and there is not yet enough information"*
>
> *" I think Posiva communicates the things it wants to communicate. There should be a completely independent and neutral, but yet powerful direction, that should conduct a study on the subject and would publish a report on it..."*
>
> *" I would say it has been misleading. Too positive picture has been given compared to reality."*
>
> *"Posiva's communication has been glib advertising."*
>
> *"More information should be paid to trustworthiness of the information as a whole."*
>
> *"Communication as a whole has been approximate/rough."*
>
> *"Communication has not been convincing."*
>
> *"I am doubtful about Posiva's communication on final disposal."*

The respondents who are more satisfied with the information they have received emphasize the opportunity to visit the site and the information they have received directly from people working for Posiva or member of the cooperation group between the municipality and Posiva. (Corporate Image 2007)

SKB (2007) has conducted a study in Oskarshamn and Östhammar on local opinions and information needs on final disposal. The study has been conducted yearly since 2003 and the latest results are from May 2007. 801 residents of Oskarshamn and 800 residents of Östhammar have been interviewed by telephone for the latest poll, where the answer rate has been 50%. When asked what would the local inhabitants like to know about the on-going site investigations, over 20% of the respondents could not name an area of information they would need or they did not know. Also over 20% did not select any of the given alternatives (selected the alternative "other") and explained that they need information on how the process is proceeding (how long has the process gone?), where the final disposal facility will be, how

it will be carried out in practice and how are the locals being affected. Some also requested more general information or information that would be impartial.

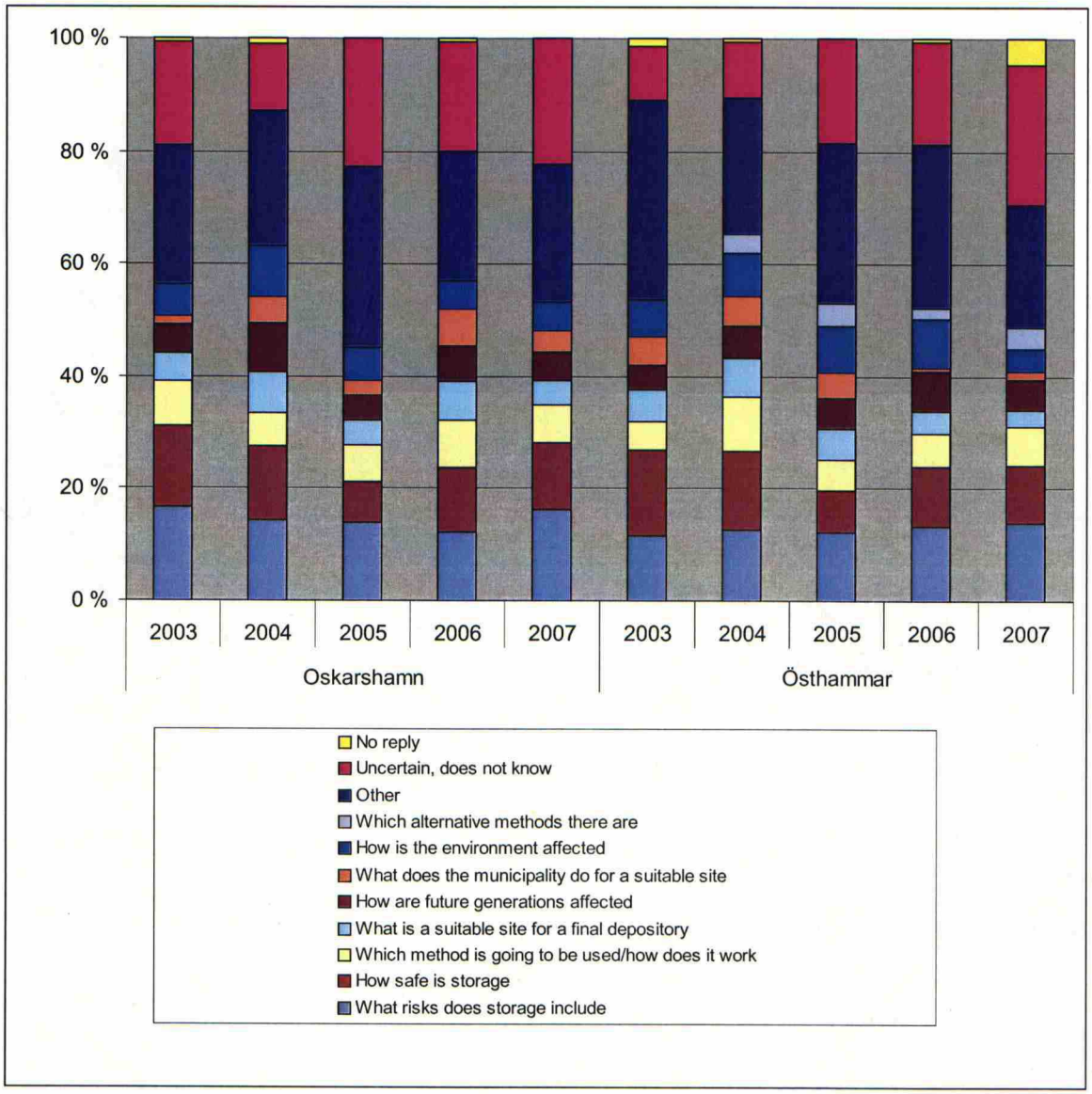

Figure 7. Information needs on on-going site investigations (SKB 2007)

Kurki (1995) has studied information receiving and seeking behaviour in three Finnish municipalities (Eurajoki, Kuhmo and Äänekoski) that were candidates for the siting of the final disposal facility. The study was conducted as a survey among samples of municipal inhabitants, municipal decision-makers and students of upper secondary schools in each of the three municipalities, complemented by a reference sample. In his research, he noted that more than half of the respondents (53%) found it difficult to gather reliable information on radioactive waste management. Almost 50% of the local decision-makers thought that

questions related to final disposal of radioactive waste were so complex that laymen cannot have an opinion based on factual information. About 20% of all respondents and more than 60% of local decision-makers reported having actively searched for information on radioactive waste. (Kurki 1995)

Hautakangas (1997) studied perceived information needs on the safety of final disposal for a Master's thesis in communication studies. The empirical part of the research consists of 19 theme interviews among inhabitants of the same three Finnish municipalities that Kurki studied; Eurajoki, Kuhmo and Äänekoski. Most of the interviewees thought that not enough information on final disposal was made available. At the time of the research, two conflicting parties seemed to dominate the dissemination of information: the nuclear energy companies and the anti - final disposal groups. Because these parties aim at influencing the opinions on the acceptability of final disposal, many interviewees found it difficult to trust the information or to formulate a general view based on factual grounds, and therefore there was a need for a neutral party that could disseminate reliable factual information without trying to create either acceptance or rejection through the information.

Based on the interviews, information with a clear agenda (pro or con) easily creates rejection, and the information representing an opposite opinion to that held by an individual was not necessarily received. Hautakangas also noted that, if the message is not formulated in a way that it can be received without extensive prior knowledge on radiation and nuclear waste, the lack of basic knowledge could hinder information seeking. In this study, the practical information needs of the inhabitants focused mainly on operations above ground, such as transportation and handling of radioactive waste, because the waste was seen to be closer to humans and also more easily affected by disturbances or accidents. This was seen as surprising, because most of the communication on final disposal of radioactive waste has concentrated on long-term safety issues. (Hautakangas 1997)

Viinikainen (1998) has studied the social impacts of final disposal from the viewpoint of inhabitants in four municipalities chosen for site investigations. Radioactive waste management issues were characterized by a number of interviewees in all four municipalities as "matters of faith", which require trust in issues about which they themselves, as laymen, have no profound knowledge. Individual experience or empirical information, as well as familiarity with the nuclear industry, were mentioned as being among the factors increasing

trust, whereas distrust was induced by factors such as previous failures in risk management and reassuring messages that there is complete control and reliability. The interviewees felt more trust towards individuals (experts, engineers) than to organisations or institutions. In this study, the amount of information available did not seem to increase trust. Almost all interviewees felt that there had been enough information available and several thought that there was "too much" information, meaning an unstructured information overload, with the same arguments being repeated in discussions on radioactive waste management. As a means of overcoming this situation, the interviewees hoped for information that would be more structured and understandable to all inhabitants. Several wanted more information from impartial sources. The implementers especially were seen as being partial, but some interviewees also thought the views of anti-pressure groups and the authorities were biased.

One way of looking at the information needs of the local residents is looking at the comments about the EIA program. It is possible for everyone to leave comments on the EIA program during a certain time period. Most of the opinions show concern about a certain issue and often also involve a need for more information about a specific subject. Hokkanen (2008) has categorized the 120 comments regarding the EIA program about the final disposal of radioactive waste into the following themes:

- Siting of the final disposal facility (12 comments by NGOs / 42 comments by residents)
- Socio-economic effects (12/41)
- General trustworthiness of safety analysis and factual information (12/33)
- EIA process and the actors involved in it (11/31)
- Alternatives considered in EIA (13/26)
- Technical details (3/18)
- EIA as an opinion poll (2/17)
- Importing foreign radioactive waste (4/8)
- Effects on the environment (not related to radiation) (2/9)
- Intergenerational moral issues (2/5).

Written comments were also presented on EIA report in 1999. A total of 15 comments were made and the following themes were presented (Hokkanen 2008):

- Safety of deep geological disposal (presented 3 times on comments by NGOs and 8 times on comments by residents)
- Alternatives in radioactive waste management (3/6)

- EIA process and the actors involved in it (3/4)
- Decision-making process and the Vuojoki treaty (1/5)
- Energy policy (1/5)
- Qualities of the bedrock (1/2)
- Socio-economic effects (1/2)
- Philosophical/moral considerations (1/2)
- Transportations (2/0)
- Importing foreign radioactive waste (0/2)
- Effects on the environment (not related to radiation) (0/1)

Heikka (2001) has studied decision-makers in Eurajoki about their views on social scientific nuclear waste management research and the development prospects of the municipality right after the decision of siting. The report is based on qualitatively analyzed interviews of three local civil servants and three members of the local council, who all have participated actively in the decision-making process at the local level and are therefore more aware of the social research than the average citizens. All but one of the interviewees think that it is desirable to locate the final disposal repository in their municipality. In this respect the sample represents the views of the local council in same proportion. As a part of the study, Heikka has also studied their information needs, focusing on the ways in which the available research information has been used and the assessments of the decision-makers about the quality and usefulness of research. According to the interviews, the local decision-makers found it difficult to find the information they needed from research reports, both social scientific and technical ones. On the other hand, information from the research was gathered in various interaction situations. Research findings were used to support decision-making and preparation of proposals as sources of arguments as well as verifying opposing views. The research information the decision-makers seemed to need in the future include (i) monitoring the changes in attitudes at the local level, (ii) consumer studies (e.g. changes in demand for foodstuff produced in the area) and (iii) impacts of the final disposal facility to local industry (agriculture, subsidiary trade, production of food supplies).

The local decision-makers interviewed for Heikka's (2001) study thought that their demands for research information have been mainly answered when formulating the research questions. One of the interviewees said that everything they have asked for has been dealt with in the research, but was unsure if something was still missing. Heikka sees different collaboration

groups (group for publicly funded research programmes, co-operation group between Posiva and the municipality of Eurajoki, so called Vuojoki group etc) as helpful in transmitting the information to decision-makers. Personal contacts were also mentioned. However, her study does not address the processes of how the information needs are formed, but she sees that multiple facts and interrelationships have an influence on why some issues or questions are defined as important and others less important. Also a study by Hokkanen and Kojo (2003) found that local decision-makers considered the local economic aspects as the most important criteria for decision-making. They saw EIA process as a producer of important information for the decision-making process, but the local decision-makers were unable to distinguish the current information producer or forum from each other. Hokkanen and Kojo also see that EIA broadened the knowledge base of the local decision-makers and structured the conversation. The members of the local council in Eurajoki consider the EIA process as a democratic arena enabling participation, but Hokkanen and Kojo saw Posiva dominating the interaction.

Drottz Sjöberg (2001) has studied problems in communication about nuclear safety issues within the local community in Oskarshamn. A total of 42 nuclear safety professionals as well as local decision-makers and employees of the community were studied using focus group discussions and questionnaires. Issues such as how relevant information could be identified and how lay people could interpret and summarize the vast amounts of information, were discussed in the focus groups and later evaluated by questionnaires. The study showed that while ability to synthesize was a good predictor of communicative ability in the group of nuclear personnel, but things like human and structural aspects of information transmission and ability to reach across boundaries were predictors in the group of Oskarshamn municipality personnel. Suggestions of the study include for example clarification of target groups of information, increased clarity regarding specific roles and guidelines on how to prioritise the material on nuclear safety, interpreting technical matters and terminology into common language, and training on how the media works. Based on her study, she found that in order to be able to communicate complicated issues in nuclear safety, the issues have to be considered on two dimensions, structure and content. Drottz Sjöberg saw "structure" as a social-technical dimension that gives the outline to the problem and "content" as a knowledge dimension between things that are known and things that are unknown.

Degree of difficulty in order to understand the content (UNKNOWN - KNOWN)	Complexity of the problems structure (SOCIAL - TECHNICAL)	
	Low	High
Low	everyday/ordinary known	factual foundation overview conclusions
High	roles attitudes feelings	context theories, systems validation

Table 3. Ability to communicate as a function of degree of difficulty of understanding the content and the complexity of the problems stucture (Drottz Sjöberg 2001, p. 40)

Everyday situations with low degree of difficulty and low complexity lie in the upper left hand corner. In the upper right hand corner are problem situations, which include high level of structural complexity, but low level of difficulty (understanding what is being said) for example in a case of illustrating a complicated chain of events in a way that is easy to understand. In the opposite corner are situations that are well known in their structure, but difficult to understand, like human behaviour for example in different roles, attitudes and feelings. The last square deals with situations where both structure and content are difficult to understand, for example problems in trying to validate facts, knowledge or belief systems. (Drottz Sjöberg 2001)

3.4.1 Information sources

This chapter presents the preferred ways of accessing the information as well as other considerations regarding different information sources.

In Eurobarometer study, NGOs and independent scientists in the home country of the interviewees were the most trusted sources of information on radioactive waste management. Compared to the results in 2001, trust towards NGOs, international organisations and

independent scientists has increased, whereas national governments and the media are not trusted as much as before. In 1999, the favourite sources of information were the national government (45%) and the media (43%) (EC 1999). The results vary when the socio-demographic variables and nationality of the respondents are taken into account. On average, the respondents who felt well informed on radioactive management and those in favour of nuclear energy tend to trust a wider variety of information sources than the others. (EC 2002, 2005)

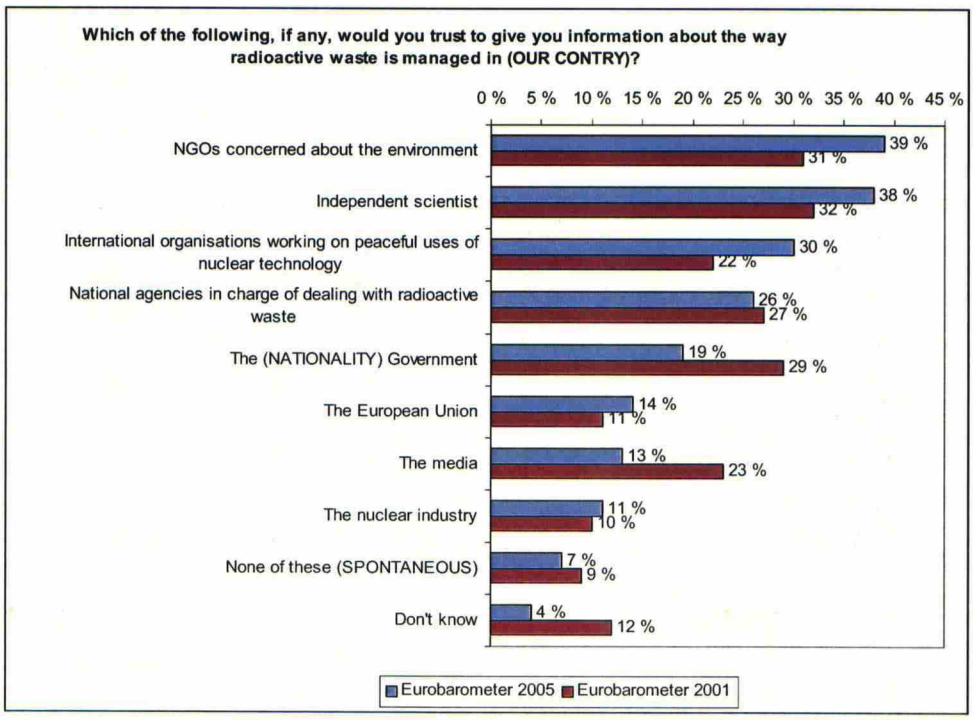

Figure 8. Sources of information (EC 2005)

In terms of involvement in the decision making process, a total of 59% would like to be directly consulted and to participate, 22% of all respondents would like local NGOs to be consulted and to participate and 13% would leave the issue to authorities to decide (EC 2005). In Finnish Energy attitudes study the most reliable sources of information were the Radiation and Nuclear Safety Authority (STUK) (79% consider reliable, 11% unreliable), energy researchers and research institutions (79%/16%) and the Ministry of the Environment (76%/16%). By examining the difference between the number of positive and negative estimates, energy companies and electricity producers (-18), the electricity sales and distribution companies (-16) and the political decision-makers (-14) have the lowest credibility. (Finnish energy industries 2006)

In his study on information receiving and seeking behaviour, Kurki (1995) found out that newspapers, local papers and television were seen to be the most important sources of information on radioactive waste management. It has to be noted that since the study was conducted over 10 years ago, the importance of, for example, the internet as a source of information, was not studied. Only a small percentage cited radio or literature as their most important source of information on radioactive waste management. The respondents relied most on the expert opinion of governmental agencies (Radiation and Nuclear Safety Authority (STUK), Ministry of Trade and Industry) and universities, whereas the reliability of experts from the nuclear industry or environmental protection groups was seen as equal.

The inhabitants of Kuhmo, who were most critical on their views on radioactive waste management, relied more on the expert opinion of environmental groups than the residents of other municipalities and less on experts from the nuclear industry. (Kurki 1995)

During the Finnish EIA process, EIA contact persons were nominated in all four municipalities to act as liaisons between the municipality, its residents and Posiva. During the hearing of EIA program, the contact persons were contacted only 13 times, and in eight of these cases, they were asked a question or requested for more information. According to Hokkanen (2008) participation in the EIA process outstripped the EIA contact persons.

3.5 Risk perceptions

Experiences of risks regarding nuclear waste management arise from sources that cannot be controlled by the implementers of radioactive waste management – or are not even connected to radioactive waste management per se, but more to the nuclear industry as a whole. According to one survey, the risk perception of the layman is based on factors such as little knowledge about nuclear energy, severe accidents (such as Chernobyl), nuclear weapons and the nature of radioactivity (cannot be seen, smelt or touched) (OECD/NEA 2003).

Citizen's fears, concerns and conflicts around nuclear waste disposal have been assessed as part of the EIA in Finland. Kantola (Kantola 1999) interviewed ten social scientists and reviewed previous studies on social impacts for his report. Previous studies show similarities in fears and concerns people associate with nuclear waste disposal. The main concerns are change in the image of the municipality, development of the municipality into something that is no longer familiar, experiencing health and accident risks and experiencing feelings of unfairness if the final disposal facility will be located in the home municipality. The extent of concern varies from unstructured fear to a very structured and analytical argumentation.

Kurki (1995) found out in his study, that more than half (53%) of the respondents were afraid to live close to the final disposal facility, but only one fifth would consider moving due to the final disposal facility. Fears attached to radioactive waste include, for example, that it would no longer be possible to hunt or to pick berries from the forests in the vicinity of the final disposal facility (40%), a hazardous cloud from the final disposal facility (24%) or bad image of the municipality (54%). Overall, the respondents were not very well aware of the positive effects to the municipal economy and employment. One third (34%) thought that large economic subsidies would make final disposal more acceptable, whereas 44% did not.

Paavola and Eränen (1999) have assessed the potential psychosocial consequences of spent fuel disposal, treating disposal as a fear-arousing and stressful situation. The focus was not only on stress reactions and coping mechanisms on individual and communal levels, but also touched on issues dealing with participatory governance processes. The researchers made a distinction between participating in the decision-making process and influencing the decision

being made. From a psychosocial point of view, it has different effects on individuals and communities depending on whether inhabitants can make a real difference in the decision-making process by influencing the decision in a way which is important and meaningful to them or if they participate in the decision-making process merely though traditional methods (such as voting). Traditional methods were sometimes seen as ritualistic, and not having a real possibility to influence the decision-making process. Individual perceptions of the real nature of the possibilities to contribute to decision-making process are connected to feelings of self-evaluation, safety and control of the living environment.

Rowe and Wright (2001) have compared expert and lay judgments of risk and they have found that counter to common beliefs among risk perception researchers there is little empirical evidence that experts judge risk differently from members of the public or that experts are more veridical in their risk assessments. They conclude their article by saying that:

> *"Differences in expert/nonexpert risk judgments, if they exist, do not imply that one set of judgments has greater validity than another. "Believable" risk assessments produced by those recognized as "experts" are not, necessarily, valid risk assessments."*

Overall the decision-makers interviewed for Heikka's (2001) study on views of social scientific research on nuclear waste management and development prospects of the municipality in Eurajoki seemed to think that the municipality would benefit from the final disposal facility, but they also saw various risks for a positive future. The positive impacts the decision-makers brought up include most of all the manor of Vuojoki, which has been rented to Posiva with plans to develop it for cultural, tourism and educational purposes. Other positive impacts include increase in population, research and development activities, networking, employment and local economy. On the other hand, the decision-makers were concerned about risks of Eurajoki being stigmatized as a nuclear waste tomb or dumping ground, which could lead to loss of population and problems with the local industry. Other threats include imported nuclear waste from other countries, the impacts to employment and economy occurring later or being lesser than expected, and also social problems during the construction phase.

3.6 Questions remaining open after the literature review

There are several studies touching on the information needs, level of knowledge, preferred information sources and concerns of the local public in Eurajoki and other municipalities that were candidates for siting of the final disposal facility in Finland as well as Oskarshamn, Östhammar and some of the earlier candidate municipalities in Sweden. There are also some studies focusing on the information needs and use of different sources of information of the local decision-makers. There is enough earlier relevant studies available to answer the research questions concerning these two stakeholder groups.

Professors in social and environmental studies have been evaluated with respect to their opinions and insights on radioactive waste management, but not specifically about their information needs or preferred ways of access to information. The students in social and environmental studies and their information needs have not been covered at all by previous studies.

Therefore the information needs and preferred ways of access to professors and students remain unknown after the literature review.

4 RESEARCH DESIGN AND METHODOLOGIES

The research questions have been presented in Chapter 1 when explaining the purpose of this research. Several different research approaches and strategies could have been used to study the information needs, but the choices in this study have been made bearing in mind the purpose of this study and the objectives of the OBRA-project as a whole and therefore considerations of the information best suited to the purposes of the observatory-to-be have been predominant. In this chapter I will introduce and justify the basis for research design, chosen methodologies and methods to come up with answers to the above mentioned research questions.

4.1 Research approach and design

The knowledge claims stated in this research are by nature pragmatic and also socially constructed. They are pragmatic in the sense that the knowledge claims – trying to understand the information needs and the preferred ways to access the selected target groups - arises out of actions, situations and consequences, and there is a concern with applications – developing a practical approach for the observatory. Focus on the research questions and approaching them from a pragmatic angle, gives a rationale for using multiple methods for research. The knowledge claims are socially constructed in the sense that this study tries to look for the complexity of views rather than narrowing meanings into a few categories and it also focuses on a specific context in which people live and work. This is a vital point in this research since each stakeholder group approaches the questions of radioactive management from their own standpoints and from very different contexts and the goal is to understand their own information needs (Creswell 2003).

Application of the theoretical foundations of this study lie in knowledge-based view, stakeholder theory and governance. Each of these theories or approaches offers important elements or concepts that could be used in analysing this complex area. Even though multiple theories present a risk of losing focus, each of them has its own function and they complement each other. Knowledge based view presented in a number of diverse theories under the umbrella of knowledge management is a usable foundation for understanding the

concept of information, the underlying factors behind individual information needs and also information seeking and use behaviors.

After approaching the information needs from an individual perspective, the organizational knowledge creation and transfer can be touched upon to give an insight on how to formulate the information contents and how to disseminate the information using appropriate technologies and communication channels so that the information needs of various stakeholder groups would be fulfilled.

Stakeholder theory gives insights to identifying different stakeholder groups and also examines the ways and means how the company can form a relationship with different stakeholder groups (Freeman 1984). In the field of radioactive waste management, the actors on the national and even on the European level are few and the actors are strongly interconnected, so the stakeholder network presented by Phillips (2003) can also be applicable. The theoretical and conceptual basis of governance of radioactive waste management will also be introduced and is clearly needed in order to understand the present state of affairs in governance, especially in the two countries, Finland and Sweden, used as examples in this study.

The theoretical background mentioned above and explained in more detail in Chapter 2 also served as the analytical framework guiding the data collection and analysis.

The design of this study can be seen as a case study focusing on the site selection processes in two different countries, Finland and Sweden. The focus in each country will be different because the two countries are at a different stage in their decision-making processes. The decision in principle has already been taken in 2001 in Finland whereas the siting decision is foreseen to take place in Sweden in 2009.

4.2 Methodologies

Knowledge based view together with governance and stakeholder theory provide the concepts and a methodology used in this study. The theories are explained in more detail in Chapter 3 outlining the theoretical and conceptual context. Basic concepts of information and knowledge as well as different approaches to information needs were presented in the same chapter under knowledge-based view.

In order to meet the research aims, methodological triangulation (sometimes called a mixed-methods approach) was used with an emphasis on the use of qualitative methods. Both numeric information (e.g. results from previous surveys, questionnaires) as well as text information (existing studies) were gathered.

The aim of the interviews was to find a small group of professors from different fields of social and environmental sciences with different backgrounds in Sweden. I selected Sweden as the country for this study because the siting decision for the final repository has not yet been taken there. The OBRA project partners from the Lund Universtity Centre for Sustainability Studies and the Royal Institute of Technology in Stockholm helped me in finding the professors for the interviews through their networks. I interviewed five professors in different fields of social and environmental sciences for this study. I used semi-structured interview, sometimes called a focused interview, to find out the information needs of the professors in social and environmental sciences (Hirsjärvi & Hurme 2000). The interviews focused on certain pre-selected themes, which were chosen based on an analysis of the content or situation. I chose this method in order to gain in-depth information on a complex issue supposing that the answers from different people can vary considerably in depth and focus. A semi-structured interview also gives an opportunity to clarify the answers and to gain information that is more profound. A semi-structured interview also stresses the position of an interviewee as an active participant and a subject that freely constructs meanings. In semi-structured interviews, the same topics and themes that were discussed with each interviewee but the exact wording or order of the questions was not determined beforehand. Depending on the interviewee, some themes were emphasized and the interviewer made specifying questions depending on the discussion. I chose the interview themes based on the theoretical

background of this research, the outcomes of the working groups at the first OBRA workshop and also the objectives of the OBRA-project. The interview structure is presented as an Annex I of this report.

I studied the information needs of the local communities and local decision-makers through literature research from existing research reports and surveys. Most of them were conducted during the Environmental Impact Assessment in Finnish municipalities. The review of the relevant previous studies were presented in Chapter 4 and analyzed regarding the research questions of this study in Chapter 6.

Sequential procedures were used to develop the research and elaborate on the findings. The OBRA project partners from the University of Lund and Royal Institute of Technology in Stockholm together with the professors I interviewed helped me to select student groups for this study. Because I anticipated that the students would not be very familiar with radioactive waste management and would not consider themselves as stakeholders in this issue, I decided to familiarize them to the subject of radioactive waste management beforehand. For this study, we had three short presentations on the basics of radioactive waste managementby myself and two representatives of the OBRA project partners. The presentations took place on October 9 and 26, 2007 at the Royal Institute of Technology and on November 6, 2007 at the Lund University. After each presentation, there was a group discussion, which was followed by analysing their information needs based on a questionnaire. Also the students, who did not attend the presentations or group discussions, had a possibility of filling in the questionnaire. The exact research methods for this group were based on the findings of the interviews with the professors and the specific field of study of the student groups.

Good scientific practice was followed in planning, implementing and reporting this study (Hirsjärvi et al. 2007, National Advisory Board on Research Ethics 2002).

4.3 Limitations of the study

This research has been conducted using methodological triangulation including interviews, questionnaires as well as reviewing previous research. The aim of this study was to provide knowledge on the information needs and preferred ways of access to information of specific

stakeholder groups and to give suggestions on how to create a pilot observatory for long-term governance of radioactive waste management in Europe. As for the groups in academic communities, students and professors, it has to be noted that the sample was limited to few universities in Sweden. Because the sample was so small, it limits the ability to generalize the results and risks the results being biased in some way, but because of the small sample it was possible to go deeper in the interviews. Also the fact that the language of the professor interviews was English, and neither the interviewer nor the interviewees were native speakers might have an effect on the results. On the other hand, the sample is heterogeneous on many accounts and gives insight from different perspectives.

4.3.1 Reliability

By reliability, it is meant that the study does not include contradictions or possible ambiguities can be explained logically. Also the method has to be so well described that the results can be replicated. In qualitative studies, the replication of the results is not as straightforward as in quantitative studies, and therefore the reliability of the study in this traditional sense is hard to evaluate.

The information needs of the stakeholder groups vary from one group to another and there are also big differences between individuals in each group. The information needs are always fuctions of the situation as well as previous knowledge, attitudes and risk perceptions. The information needs depend very much on how much the person already knows about radioactive waste management, in what way does he or she participate in the decision-making process and what kind of attitudes or fears he or she has regarding radioactive waste management. Therefore no accurate measure of the amount or quality of information needs cannot be obtained, but I believe that the results of this study describe the main issues raised on information needs of the stakeholder groups well enough. It also raises the individual concerns and distinctive voices, and does not only present the average.

4.3.2 Validity

Material is valid when it describes the object it is supposed to describe and it does that as reliably as possible. The purpose of this study was to find out the practical information needs

and preferred ways of access to selected stakeholder groups, which were candidate municipalities for siting a final disposal facility in Finland and Sweden as well as university professors and students in social and environmental sciences.

One difficulty of assessing the validity comes from the definition of "information needs" and the fact that the different stakeholder groups in this research have a very different need for information on radioactive waste management. According to the Sense-Making Model of Cognitive Needs information needs arise from situation stops, when the way ahead is blocked due to lack of information and the individual must find a way to bridge the information gabs (Dervin 1992). In this study, the information needs have been dealt with more freely, speaking more about "expressed demand" (Haasio & Savolainen 2004) or "information seeking towards the satisfaction of needs" (Wilson 1981). Whereas the local decision-makers have a clear need for information and they know that they are affected by the situation. On the other hand, groups such as university students may not view themselves as stakeholders in this issue and therefore do not have so imminent need for information.

Since the study was conducted in Finland and Sweden, the results may not be fully applicable in other European countries. The different culture, cultural validations, the way in which the process of siting was handled including the amount and nature of information available all have an impact on the information needs. But since Finland is the first country where the site is already selected and site investigations on-going in two Swedish municipalities, these countries provide a valid case in this respect.

5 INFORMATION NEEDS ON RADIOACTIVE WASTE MANAGEMENT

This chapter reviews the results of this study, gathered both from primary (interviews of professors and students of social and environmental sciences) and secondary (previous relevant studies on information needs of local communities and decision-makers) sources. I will present the information needs and preferred ways of access of each group separately.

5.1 Information needs of residents of local communities

I have used secondary information from previous studies for finding out about the information needs of residents of local communities. Most of the research findings are from Eurajoki, which has been selected as the site for final disposal facility in Finland. Research findings are also available from Oskarshamn and Östhammar, which are currently the candidate sites for final disposal facility in Sweden, and also from Finnish and Swedish municipalities, which have previously been considered possible sites. The relevant previous studies were presented in more detail in Chapter 3.4.

The information needs can be discussed on various levels. I will start by presenting the themes or specific topics on which information is requested. Then I will move on to other expressed qualities of the information and finally to the preferred ways of access.

Additional information needs have been expressed in different studies about the following themes with examples of typical questions (e.g. Corporate Image 2007, SKB 2007, Hautakangas 1997, Hokkanen 2008):

- safety (how do I know it's safe?, what risks are involved?)
- long-term effects (how are future generations affected?)
- radioactive waste (what it is?, for how long does it stay radioactive?)
- radioactive waste management (alternative methods?, why this approach was chosen?)
- handling the waste before final disposal (how does it work in practice?, transportations?, storage?)
- technology (technical details?, reliability of safety analyses?)
- site selection process (criteria for site selection?, role of the municipality?)

- effects to environment and health (how will I as local resident be affected?, how will it affect the environment?)
- socio-economical effects (effects to municipal image?, effects to local economy?)
- imported waste (will there be imported waste from other countries?)
- updates (what has been done?, what is done currently?, what will be done next?)

It is notable, that the group of local residents is quite heterogeneous with regard to their current level of knowledge, their interest on the subject as well as their attitudes. Many residents of local communities rate their knowledge on radioactive waste management as poor (Viinikainen 1998), they are unable to name their information needs (SKB 2007, EC 2005) or when asked, they can only name very broad areas of information (such as safety) as their need for information (Corporate Image 2007, SKB 2007). As Hautakangas (1997) mentioned, the lack of prior knowledge can hinder the search for information, because the person does not know where to start or how to evaluate the importance of materials, if a lot of information is presented. Therefore very basic information has to be available for those with low level of knowledge on the subject. Some people also voiced their personal considerations (e.g. *How will I be effected?)* as the areas on which they need more information on.

On the other hand, there are local residents with considerably better understanding about the subject. Those can for example be people who have a strong opinion on the proposal and want to promote their cause by participating in decision-making, or the ones who already have close connections with existing nuclear facilities in the community. Hokkanen (2008) suggested in his dissertation that policy instruments like EIA can possibly create a new elite – active lay experts. They can request far more specific information on radioactive waste management and its effects, than residents with low level of knowledge.

Because the information needs among the residents of local communities are so different, also the preferred ways of accessing the information differ. Many local residents find it difficult to find the information they need from research reports, but prefer a more simple presentation in lay terms involving interpretation on the findings. Face-to-face contacts, ability to visit the site, personal contacts they can trust or participation in decision-making process (information meetings etc.) were regarded as important sources by some local residents. Printed information like newspapers or information brochures distributed locally were another group of important sources of information. Some local residents have also voiced a need for more

impartial party that could disseminate information since the communication of the local implementer has sometimes felt like lacking credibility. Particularly in this question concerning radioactive waste management, information is needed for decision-making, but the attitudes and concerns people have, can guide their decision-making even more than factual information (Elam & Sundqvist 2006).

5.2 Information needs of decision-makers at the local level

For this study, I reviewed the previous studies touching on information needs of local decision-makers (e.g. Heikka 2001, Drottz Sjöberg 2001, Kurki 1995). The studies and their findings were presented in more detail in Chapter 3. This chapter focuses on information needs the local decision-makers have in order to participate in decision-making on siting. They are, of course, also residents of local communities having similar kinds of information needs and considerations as the other residents, but they require also different information in their roles as decision-makers.

On average, local decision-makers had considerably better knowledge on radioactive waste management than other local residents. They also reported having purposefully sought for information on radioactive waste management considerably more frequently than the other stakeholder groups in this study.

As a whole, local economic aspects were identified as most important factors on which local decision-makers based their decisions and they also needed information on. Effects of the planned final disposal facility of high-level radioactive waste to local economy could be either positive or negative. Positive effects might include things such as increase in population, increase in research and development activities at the local level, networking, positive effects to employment (during site-investigations, construction or creating permanent jobs) and through that positive effects to the local economy as a whole. Negative effects include effects to municipal image resulting in other negative impacts such as loss of population or problems to local economy. Local economy might also be affected by loss of demand for local products. For example in Eurajoki, decision-makers were concerned about how the demand for foodstuff produced close to the final disposal facility would be affected.

The local decision-makers seemed to need specific studies on these areas in their own communities by independent researchers, who were experts on local economy. The local decision-makers also seemed to value the possibility of influencing the areas being studied as well as the selection of the researchers.

Also the decision-makers needed information on attitudes of the local community. Because they were representing the local residents, the decision-makers wanted to know how many of the local residents were supporting and how many were opposing the proposal. Also the psycho-social impacts of the siting were studied in order to understand the reasons behind the attitudes as well as the possible impacts of siting.

Local decision-makers needed information also on various technical and natural scientific topics to back up their own arguments as well as to verify opposing views. The information needs in these cases seemed to be very specific, because the information was needed for a known cause in a decision-making process.

Information channels that were identified in the previous studies include interaction with different groups, experts and contact persons. Personal contacts were very much emphasized in many studies. On information sources it was referred to scientific studies, but it was mentioned that it was difficult for local decision-makers to find relevant information from research reports. Instead, the local decision-makers seemed to rely on expert opinions on the relevance and reliability of information. It seemed that they did not use research reports as their primary source of information, but used them as references. Trusted contact persons or groups, who could explain and "filter" the information needed from the scientific literature, were very important sources of information for local decision-makers.

5.3 Information needs of professors in environmental and social sciences

This part of the reports aims at finding out the practical information needs and on the other hand the preferred ways of access to information of professors in social and environmental sciences. I also asked the professors if they would have a suitable student group that could be used as a target group of this study to find out about their information needs.

I contacted seven professors by phone or e-mail and based on those contacts, made six appointments for interviews. I interviewed five professors in Sweden between June 8 and June 12 2007. One of the interview appointments was cancelled. I scheduled one hour for each interview and the interviews took 40 to 75 minutes. The interviewed professors came from four different universities; The Royal Institute of Technology in Stockholm, Stockholm University, Karlstadt University and Lund University. They were chosen based on their different fields of study and different background.

Before the interview, I gave the professors background information on the OBRA-project, namely that this is a feasibility study for a European observatory for long-term governance on radioactive waste management, which aims to be the central point of reference when seeking information on radioactive waste management. I told them about the observatory, that it should have a multidisciplinary approach and instead of merely disseminating information, it should also provide mechanisms for a dialogue between different stakeholder groups. The professors were also informed about the aims of the interview and about the company (Posiva) I am working for. I did not give the definition of final disposal of radioactive waste management or long-term governance of radioactive waste management at the beginning of the interviews since one of the aims was related to how the professors themselves understand radioactive waste and radioactive waste management. After the question, I explained that the study deals with mainly the siting phase of a final repository of spent nuclear fuel.

The themes of information needs and preferred ways of access to information were discussed quite broadly depending on the kinds of anticipations the professors had about the information. I recorded and transcripted the interviews in order to be able to analyse the data. Based on the transcripted interviews I analysed frequent patterns and distinctive views as well

as possible, bearing in mind that the answers differed significantly. In this chapter, I am trying to bring up the most typical views and interesting propositions from the development perspective. With each question or issue, I mention if the answers are unanimous or representing the views of majority or just one interviewee.

5.3.1 Background

The academic background of the professors included theoretical philosophy, sociology of law, environmental studies, psychology and national health science. Their research interests covered such areas as for example sustainable development, philosophy of risk, philosophy of science, risk analysis, climate change, environmental policy, NIMBY mechanisms as well as human factors and safety in nuclear industry. The interviewees also differed in their background regarding experiences with the nuclear industry. Some of the interviewees had a history of working with nuclear industry in narrow research areas but some had no previous experience in working with the questions related to nuclear industry nor any affiliations with any companies, organisations or research programs in nuclear industry. Only one professor in five had worked on questions concerning radioactive waste management for a short period many years ago, but the others had never worked in this area. All the interviewed professors were male. The age of the professors differed from one professor being under 40 years old to two being over 60 years olds.

5.3.2 Attitudes on nuclear energy and radioactive waste management

The attitudes on nuclear power as an energy source differed from being quite neutral to strongly opposed. Those taking a neutral stance claimed either not having enough information on the field to form an opinion or not considering the present state of nuclear power as a sustainable solution, but thought that maybe future technological developments could make it more sustainable. The arguments for being opposed to nuclear energy included strong role of commercial interest leading to lack of trust, issues of creating a burden for future generations, risks of misuse to nuclear weapons or the real cost of nuclear energy if all costs (incl. decommissioning) would be considered. One professor also pointed out the question of nuclear energy production in different countries. In his opinion, due to the differences in culture and stability of political system, nuclear energy cannot be the energy solution for all

countries, and therefore I should not be adopted by any country. The following is a direct quote from his interview :

> "*And also the big problem with civilian use of nuclear power is that if we accept it, we have to accept it is the energy solution for everybody and I don't want to live in the world where we have 100, 120, 150 countries in the world with nuclear power. So therefore I think it is utterly wrong that certain countries who think they can master the technology (..) and probably also can, that from moral standpoint I would say it's utterly wrong to develop a technology which (..) have these considerations, ramifications both in future generations and when it's adopted by other countries (..) where we have no possibility at all to control what will happen with the side effects.*"

The attitudes on being in favor or opposed to final disposal of nuclear waste were not as radical, partly due to lack of knowledge on radioactive waste management. Some professors had no opinion on whether the plans for final disposal of spent nuclear fuel should be continued in Sweden, but most of them thought that since the waste exists, some decision must be taken instead of leaving the issue to future generations. Some did not see the question on radioactive waste management as a separate question from the nuclear industry as a whole.

5.3.3 Information needs

This chapter reviews the results of the interviews with five professors. It starts by examining the present state of knowledge on radioactive waste including their definitions on radioactive waste and radioactive waste management. Then it covers the current information needs and the needs for information, if they were asked to form an educated opinion on the siting of the final repository and finally some remarks on their information seeking strategy.

Present state of knowledge

The present state of knowledge regarding radioactive waste management was very different among the interviewed professors. Three out of five claimed to have pretty good knowledge

on nuclear energy, but most of them said they did not know so much about radioactive waste management. Two of the interviewees rated their knowledge on both nuclear industry and radioactive waste management as not particularly good or being very superficial. All had some prior knowledge on radioactive waste management but most of them had not purposefully sought for that information but they had gathered their information by following the mass media, especially during the referendum on nuclear power in Sweden in 1980. Some had also learned about questions surrounding radioactive waste management in seminars or conferences they had attended in their own research area or research publications in some of the journals they follow. That is why professors had a very different perspective to radioactive waste management depending on their research area. Some professors had a little bit more personal interests in the question of radioactive waste management, either as being "*an enlightened citizen*" or living close to a potential final repository site, and they had at some point looked into the field a little closer. Several mentioned that the nuclear waste issue is not topical in Sweden at the moment. Following Choo's (1998) general model of information use and Dervin's (1992) Sense Making Model of cognitive needs, the professors do not have a real information need in the sense that they would have to face situation stops where they see their way ahead being blocked due to missing information. Their information practice could be characterized more as non-directed monitoring or in some cases active scanning, meaning that they might have identified some likely sources of information on radioactive waste management and are actively observing or listening when the topic is of their interest or that they have come across with information on radioactive waste management unexpectedly in unexpected places (McKenzie 2003).

When the professors were asked to define radioactive waste, most of them described the different levels of radioactive waste (low, intermediate, high level waste or level 1, 2, 3 etc.) and how other materials besides the fuel itself also become radioactive waste in nuclear energy production. Terms such as "negative", "risk", "danger", "poisonous", "toxic" and "conflicts" were also associated with radioactive waste.

Definitions of radioactive waste management emphasized the process of taking the waste out of the reactor until deposition, or preventing waste from being misused or causing harm to people or environment. Some people talked also about reprocessing or monitoring. Some people talked mainly about the final disposal of spent nuclear fuel and others also about the management of low and intermediate level waste.

Current and hypothetical information needs

None of the professors had a need for information at the moment at their work setting that would make them search for information on this issue or follow the discussions purposefully. However, their work settings as professors of social and environmental sciences were influencing their hypothetical information needs in the sense that the problem dimensions or criteria which they use to assess the relevance of the information to a problem is much more analytical, or they can better put it to words, than average citizens (Taylor 1991, Choo 1998). Some of the professors did not see themselves as stakeholders in the radioactive waste management question because they are not currently working on the issue and they are not personally involved in the decision-making process. Professors are not stakeholders in the traditional sense (Freeman 1984) as affecting or being affected by the organisation or company responsible for siting. When a more complex operating environment is considered, they can be seen as part of the stakeholder network having not normative obligations, but derivative legitimacy as their actions or claims may pose potential effects upon normative stakeholders (Phillips 2003). Most professors told that if they would be working on radioactive waste management field or write something about it, then they would search for more information on the field but currently they are not planning to do that. Some stated that there is already so much information on this subject that it is impossible to learn all of it.

The following comments from two professors illustrate the needs of the professors fairly well. At the moment they do not have a specific reason to gather information on radioactive waste management. Even though they have not studied the field so closely, they have a feeling that there is a lot of information available.

> *"I think that the information is available and I don't see any particular need of information"*

> *"I don't think there is need for more knowledge or the technicalities and details but there's need to be more information and discussion about the big picture."*

Need for a general overview

One common concern with the interviewed professors was the difficulty of assessing the large amount of information on radioactive waste management. It was regarded difficult to know which materials could be trusted. To achieve more trust, most professors agreed that some kind of objective evaluation of specialists was needed to get a broad picture of the field. In one way or the other, all the professors saw a need for an overview or a complete model of radioactive waste management that they could trust, to start with. Another way of achieving transparency could be to have overviews from different parties (for example proponents and opponents) at the same time and be able to compare the two. Many interviewees hoped for information that would start quite generally, but there would be a possibility to go deeper. Maybe even follow it to the scientific foundations by references.

Below are some ideas of the kind of overview brought up by professors:

- complete model of the procedure showing radioactive waste management from the very beginning to the end, including a time diagram
- things we actually know vs. the things we don't know
- things that are regarded as a problem vs. things that are not regarded as a problem.

The next quotation from one professor captures the concern for information or knowledge, which he would like to see if he would seek for information on radioactive waste management:

> *".. what I'm mostly interested in this area, is the relations between what we in fact know about, the risks, and the things we do not know. Normally I find that it's rather easy to get information about what we know, those are the things that are easy to put in the database, but to get a good picture about the things we do not know but might be relevant in making an informed, rational decision, that kind of information is not structured in a good way, so if I'd turn to this kind of information subject, I would value very much having some kind of structure there, informing what kind of fields.. what are less well examined or investigated."*

Some did not want to limit the discussion merely on the management of spent fuel and long-lived radioactive wastes, but called for the big picture; to include all waste types, or the whole nuclear industry, into the discussion. From their standpoints, radioactive waste management is always part of the larger system and should not be considered separately from that context.

Areas of information

The professors were asked what kind of information they would need if they were asked for an educated opinion on siting the final repository in Sweden. Below are the areas of information that were mentioned:

Information area	Questions	Times mentioned
Safety issues	How society handles hazards? How incidents/disturbances are handled? What kind of policies there are about incidents? Who are the main actors (in incident handling)?	3
Technical issues	General overview of the system. Different technologies.	2
International issues	Whose waste is deposited in Sweden? Who is going to manage the waste disposal in Sweden?	2
Environmental aspects	How would final disposal change the nature around the site? How are the ecological impacts assessed? What will the landscape look after?	2
Risk analysis	How risk analysis is made? What are the criteria? What are the methods? What are the parameters you are looking for? What is the safety analysis process? How is validation made? Comparisons between different countries (in risk analysis)?	2
Involvement	How to solve social-technical problems? How to get lay participation? What are the means?	2
Time perspectives	What are the implications in a 20-30 years perspective in addition to very long (10000 years)	2

	perspective? What is seen at particular point of time vs. what is valid for a longer time perspective?	
Political decisions	What are the main decisions that have been made? What are the criteria? What are the main issues that have to be decided? What kind of regulations there are?	2
Transportations	Risk analysis of transportations? Are there going to be transportations between countries?	2

Table 4. Information areas mentioned by professors

Also such issues as risk perception, safety of political system, waste handling process at the moment, implications for future generations, risk of being misused and costs of radioactive waste management (including decommissioning) were mentioned at least on one occasion.

Sometimes a need for information was requested to be viewed from another perspective than it has traditionally been handled. Long-term safety of final disposal is one of the key criteria, which is assessed for licencing to ensure the suitability of the technical solution and the site for a very long time period after the repository has been sealed. Below is a quote from one professor's view of assessing the long-term safety of radioactive waste management not as a technical or natural-scientific question as it has been dealt with up till now, but as a social-political question.

> *"the big question is not really how safe is our engineering solutions, but how safe is our political system. That and how can we guarantee, or I mean we can't guarantee, the political system more than, not even this generation perhaps. [..] I think it's very important to determine the long-term safety of these projects because I don't think it's an engineering problem, it's a social-political problem."*

The professors were also asked to assess some of the information areas that the participants to the first creative workshop of the OBRA-project had proposed earlier. Especially the political side of governance of radioactive waste management, implementation of local democracy,

experiences in other countries and recommendations on improving decision-making were interesting topics to many professors. Technical information was also an interesting area, but most of the interviewees needed just a very broad, general overview of technical solutions, not the details. One pointed out that a broad overview was needed because typical engineering solutions might be safe in one area, but there is a need to assess them as one complete solution.

Anticipations for information

This part of the chapter summarizes the qualities of desired information not mentioned before as well as the characteristics of the kind of information that was not wanted.

The information should be "user-friendly" in the sense that the user has a possibility to assess to what degree the information is certified or not. Some mentioned that there was already enough information, but it was more the way in which the information was disseminated than the information itself, that mattered. One professor saw the information from SKB at one possible test-drilling site as highly technical and highly artificial aiming primarily to get acceptance from the political decision-makers to start drilling. In his opinion, the screening and discussion process seemed to be missing. Because of that the material had low credibility to him. It should have been more independent and having more open questions, troublesome issues should have been dealt with more profoundly.

> *"it's not the facts, it's how it's handled, how the facts are obtained, it's more if you trust the process and the people who are getting the facts."*

The characteristics of information that were seen as negative in the interviews include for example:

- too fragmented (dealing only with one type of radioactive waste or one type of technical solution)
- too technical
- going into details too quickly
- too narrow-minded
- "educative" (not willing to enter into a dialogue)
- showing estimates of probabilities without making explicit the assumptions on which they are based.

Information seeking strategy

The interviewees were asked to describe their information seeking strategy on a very general level on a topic that is not very familiar to them. More than half of the interviewed professors would like to start the information seeking process by talking to a person that they consider trustworthy and who knows the field already. Selected internet sites were also mentioned on several accounts as the first source of information when trying to map the field and see what is going on in that area and narrowing the problem. Sources such as Google Scholar, ISIS, legal sources, (international) organisations responsible for a certain areas or researcher's homepages were mentioned as the first steps of the information seeking process trying to find reputed reviews of latest literature or relevant publications.

5.3.4 Information sources

This chapter starts with an introduction to the sources of information that the interviewed professors have used until now to gather information on radioactive waste management. It goes on to the sources of information that could be used now by the professors to seek for information on radioactive waste management and discusses the role of internet as an information source. Preferred means of accessing the information from the observatory are discussed and finally the issues surrounding involvement and trust.

Information sources on radioactive waste management until now

Most of what the interviewed professors have learned about radioactive waste management is through their roles as private persons, very few had looked on the subject as a professional actor. The majority had not purposefully searched for information on radioactive waste management and this is why mass media (tv, newspapers, especially Svenska Dagbladet) played an important role as an information source, especially during the debate around the Swedish referendum on nuclear energy. Thus their information practice was mostly non-directed monitoring (McKenzie 2003).

Some of the interviewed had also read investigations made by SKB, Environmental impact assessments (EIA) or journals, which have articles on radioactive waste management. Personal contacts who know more about the area (e.g. environmental laws, nuclear

regulations) were mentioned as a source of information by many interviewees, especially the ones who at some point have been working closer to the nuclear sector. Some had learned about radioactive waste management at conferences they had attended and there happened to be presentations on this issue, but the conferences were not treated as a very important source of information on this subject. These information practices can be characterized as active scanning (McKenzie 2003). None of the professors mentioned internet as a source that they had used for getting information on radioactive waste management.

Seeking information on radioactive waste management

When the interviewed professors were asked where would they seek for information on radioactive waste management, many of them would start with their personal contacts, people they trust, either within the academic world or the Swedish authorities (SSI, SKI) and work from there. Personal contacts in this case can be considered as an important channel of information. Some would start their search in the internet, conducting a survey on scientific literature using a keyword or trying to find other good sources of information in the internet to map the field.

Internet as a source of information

Internet as a source of information was dealt as a part of the discussion on the information sources. On the other hand it was seen as a prerequisite for the Observatory to have a good internet site, but at the same time internet as a source of information was questioned because the quality of information is so varied.

> *"I don't go to internet, I want safer sources [..] I use the net to find references, but if you really want to know what's going on you could send email or so on, communicate with researchers I trust"*

> *"I'm very sceptical about the internet especially in a field like this, where there is so much political interest and business interest, you have to be very careful about what are your information sources"*

Several professors mentioned that to be able to trust the information on the internet, the site has to be reliable and authorized, like the legal sources or international organisations, which were mentioned as examples of sites where you can count on the information. One professor also brought up the possibility of sabotage to the site, because the subject is so controversial.

5.3.5 Preferred ways of access

The interviewees were asked by which means would they like to receive information or enter into a dialogue if the observatory already existed. At first they were asked an open-ended question and after that they were asked to evaluate some propositions made at the first creative workshop of the OBRA-project. Because there was no current information need stemming from their work settings they were also asked in which means they would be interested if they were to seek for information on radioactive waste management.

An e-inventory summarizing and synthetizing the on-going research received most positive feedback from the interviewees in addition to the general overview discussed earlier. In order to be considered a good source of information by the professors, the inventory should be reliable and not focusing too much on the technical aspects but rather presenting the main problems and the solutions to those problems or identifying the areas where enough information is not yet available. One professor said he would not trust this, unless the review went through the similar refereed system as the annual reviews in different disciplines (e.g. annual review of sociology/psychology) with high scientific standards.

One suggested model for synthetisizing the ongoing research was an "extended peer review" (Funtowich & Ravetz 1992), which differs from normal peer reviews in that non-scientists, people without an institutional accreditation but with a desire to participate in the resolution of an issue, are also included in the assessment process. Extended peer communities are used in areas of high uncertainty and issues of quality are crucial. One example from another field is Intergovernmental panel on climate change (IPCC) (http://www.ipcc.ch/), a balanced group of scientists from different fields put together by United Nations to review and scrutinize the science in the specific area and based on that create a consensus on the things that are known and the things that are not known. Following Davenport's classification, these expressed needs can be seen more as needs for knowledge than information, because the contents the professors were describing include reflection and synthesis and is closely tied to context. This kind of knowledge is often tacit, hard to transfer and difficult to capture on machines. (Davenport 1997)

Some interviewees mentioned **library** of radioactive waste management spontaneously, but conflicting arguments were made about it by others. Some thought it would be a good idea to

have an impartial library that collects the data that is available to everyone, it should not feel like it's the material from radioactive waste management agencies. Some were not at all interested in it, they felt there was no added value to having another library, not a physical nor a virtual one. One said that if he would be really interested in the subject, he would like to visit a physical library, but three out of five thought that a web-based library, which collects relevant journals and selected publications would be a good idea.

A **database** with definitions of terms linked to governance of radioactive waste management ("Wikipedia of radioactive waste management") was considered useful by some interviewees, but maybe more to the general public than to the academic community. Big question about this type of resource is who is going to come up with the definitions and how to get also alternative definitions there.

Some kind of **virtual network, web forum or topical blog** was mainly seen as useful tools to get interaction, but at the moment none of the professors thought they would actively participate in the discussion, because they are not so close to the issue. Some of them might go and check what is going on in the discussion, and they noted that as people who are not as involved in the issues, they would prefer more passive information sources (for example a database where you could go and have a look, not participate or contribute). One professor also thought that people who consider radioactive waste management a problem, would not participate either, but they would rather work with other networks. As one example of a kind of model for interaction brought up by one the professors is a blog called RealClimate (http://www.realclimate.org) where different issues in climate change are discussed in a very reliable and balanced way. It could also be possible to use such a forum to discuss and review major publications or assess new methodologies also in the context of radioactive waste management.

Site visits as an information channel of the observatory were not seen as very important. One professor even though they would be counterproductive, because the visitors would not be able to assess the information they receive and he saw visits not as information but more as an act of lobbyism. On the other hand, some professors thought it would be very important for the observatory to have physical persons, that could be contacted and maybe visited if they would be searching for information on this subject.

Some of the interviewees saw a need for **training courses** for certain groups (e.g. local decision-makers near possible repository sites or authorities) or possibly courses where different stakeholders could communicate together on the issues. Training needs were seen especially on how to involve people, different stakeholders, into the decision-making process, not so much on the technicalities. The professors themselves did not see a need for them at the moment to participate in training on these issues, but some would be interested if they were to work closer to the field and there was a need for additional information.

Newsletters as an information channel were not generally regarded very interesting. One professor noted that he seldom reads them, because he gets so much information from different sources. On the other hand, another pointed out that because he is not currently working on the issue, he is not so interested that he would go out and actively search for information on radioactive waste, but a short newsletter to his e-mail would be good if he just wants to see what is going on in the field. In other words, he was describing non-directed monitoring (McKenzie 2003).

Questions and answers or a place for frequently asked questions was interesting to some but not all the professors. The professors were not likely to use the service themselves but it would be interesting to see what kind of questions were asked by others.

5.3.6 Interaction and trust

Throughout the discussions the issues of trust and reliability as well as the stakeholder groups who should be included in the interaction, came up. Several prerequisites for achieving trust were mentioned in the discussions. One of them was sound scientific foundation; scientific standards that were established and followed as well as the possibility to follow any claims to the scientific foundations (for example, what kind of assumptions are made). Linked to the previous was that respected researchers with good credentials create trust from the professors' point of view. Also the process should be as transparent as possible involving different disciplines, revealing opinions that are both pro and against, and revealing the organisational linkages behind the involved parties.

Lastly, many professors mentioned that the observatory should be impartial, so that people with different opinions could trust that their opinions were treated properly. One professor made a different claim stressing that there cannot exist any impartial information because according to a positivistic view all information is value-laden and therefore constitutive values (generated from an understanding of the goals of knowledge) are embedded in all information and therefore all information is biased one way or the other. One suggested way to overcome this situation would be to make the values of all involved parties very explicit and this way give others a chance to assess the information better. This could be done for example by asking the same questions (background, values, affiliations etc.) to all people involved in the discussion and other people could see his/her answers to these questions by clicking on his/her name.

The stakeholders in radioactive waste management that were mentioned in the interviews include Swedish authorities (SKI, SSI), Swedish radioactive waste management agency (SKB), consultants used by SKB, energy companies, regulators, EU, local communities (political decision-makers at the local level, citizen's board), environmental groups, academic community, competent opponents in the field, legal system (different courts in Sweden, e.g. Miljöbalken), journalists and the general public. Involving the general public into the functions of the observatory was thought to be either very difficult because they lacked the basic knowledge on radioactive waste management as well as the skills to further assess the quality of the information that was given, or taking a risk of sabotage is the system is too open.

One professor saw the role of the observatory as an information clearing house, which would by some mechanisms interpret the data available on radioactive waste management. Another said there should be a reliable party that would distill the information. In terms of the actor-network theory, the process of information review at the observatory was seen by many interviewees as an obligatory passage point, a situation that all actors in the network, both human and non-human, must pass through. Some talked about a need for an impartial chairman, one who would bring the issues into the discussion and would in this sense act as a focal actor of the actor network. (Callon 1986)

5.3.7 Radioactive waste management in education

Radioactive waste management has not been covered as a topic in the courses taught by the interviewed professors. Many professors have used it as an example or a case study when lecturing in the areas such as sustainability studies, ethics, philosophy of risk or decision-making.

Interviewed professors have used radioactive waste management as an example of

- a situation where you do not want to discount (in decision-making)
- an issue raising range of ethical considerations
- a cross-generational issue
- illustration of risk perception
- regulation issue (how to regulate an issue like radioactive waste management?)
- a NIMBY (Not In My Back Yard) phenomenon.

The examples have been passed fairly quickly partly because the lack of knowledge of the professor in this area. Some mentioned that they would be willing to use more examples on radioactive waste management in their courses if they knew of a good information source. Some kind of guidance to get into the system in the first place and also the ease of finding the information that you are looking for would make at least some of the interviewed professors more willing to utilize the observatory also with their students either during the lectures (to find facts, figures, pictures etc.) or when searching for more information.

Some did not see the point of using radioactive waste management as an example, because it was in no way connected to their field of study and they could find more illuminating examples elsewhere, or they were not teaching that much nowadays. Some professors also thought that the students might not be so interested in working with this kind of subject, which is not topical, which they don't know about it or don't care. Few thesis and smaller assignments have been written about subjects linked to radioactive waste.

5.3.8 Conclusions on professor's information needs and preferred ways of access

As none of the professors had a current need for additional information on radioactive waste management and some did not even consider themselves as stakeholders in the question of siting, the information needs were quite hypothetical. On the other hand, all professors were working on issues close or familiar to the field of radioactive waste management, so at least some aspects of radioactive waste management were of interest to them professionally. Overall, the interviews did give a good picture on the insights on how the professors in social and environmental sciences structure the question of radioactive waste management and the information needed for decision-making.

As for the areas of information, the professors named various areas around safety, technical solutions, international aspects, environmental aspects, risk analysis, involvement, time perspectives and political systems that would be of interest to them. Most of them pointed out, that there is already a lot of information available, and what was needed for them was a general overview carried out in a way it would satisfy their demands for impartiality and sound scientific judgment.

In all interviews the issue of trust came up one way or the other. As ways to achieve trust, the following features were mentioned:

- sound scientific foundations
- respected researchers with good credentials (certain organisations, that are considered trustworthy)
- revealing underlying values and affiliations.

5.4 Information needs of students in environmental and social sciences

This chapter reviews the results of this study considering the information needs and preferred ways of access of students in social and environmental sciences.

For this study, I studied 41 students on their information needs and preferred ways of access to information on radioactive waste management. The interviews took place between 9 October and 6 November, 2007, at the Royal Institute of Technology (KTH) in Stockholm and Lund University in Lund, Sweden. First, two student groups of risk management at KTH and students of environmental studies and sustainability science were invited to attend a short meeting, which aimed at providing the students with some background information and to find out about their information needs and preferred ways of access to information on radioactive waste management. The students were given a short introduction to OBRA-project as well as to radioactive waste management and deep geological disposal using short video clips from Posiva and SKB as well as a powerpoint presentation covering areas such as use of nuclear energy, different waste types, terms (interim storage/final disposal) and present status of deep geological disposal. After the presentation, there was a group discussion on information needs. The students were also asked to fill in a questionnaire (Appendix 2) covering the same questions as the group discussion. The questionnaire was later sent to all the members of selected students groups so that it was possible to answer the questionnaire without attending the information meeting. A total of 22 students (54 % of the respondents) took part in information meetings. Two of the meetings were conducted in Swedish and one in English due to the language normally used in studies. The questionnaire was also translated into Swedish for those meetings held in Swedish at the Royal Institute of Technology.

Half of the respondents were male (20) and half female (21). The average age of students was 32. Two of the student groups were full-time students whereas one group consisted of adult students. 49% of the respondents (20 respondents) were from the Royal Institute of Technology and 51% (21 respondents) were from Lund University.

5.4.1 Attitudes on nuclear energy and final disposal of nuclear waste

The students were asked about their attitudes on nuclear energy and final disposal of nuclear waste using two multiple choice questions. The choices ranged from being pro or against or having a neutral attitude towards the issue.

	pro	neutral	against	N/A
Opinion on nuclear energy	7 (17%)	18 (44%)	14 (34%)	2 (5%)
Opinion on final disposal of nuclear waste	13 (32%)	13 (32%)	11 (27%)	4 (10%)

Table 5. Student's attitudes towards nuclear energy and final disposal

On nuclear energy most of the students (44%) held a neutral position and 34% were against while only 17% in favour. On final disposal the opinions were more evenly distributed with 32% being pro, 32% neutral and 27% opposed. 5% did not have an opinion on nuclear energy and 10% on final disposal.

5.4.2 Present state of knowledge

Two multiple-choice questions were used to find out about the present state of knowledge on nuclear energy and radioactive waste management. About 49% of all respondents rated their knowledge on nuclear energy as good or rather good whereas 44% claimed to have good or rather good knowledge on radioactive waste management. Only 5% rated their knowledge on nuclear energy as poor, but 27% had poor knowledge on radioactive waste management. Overall, the students rated their knowledge on nuclear energy better than their knowledge on radioactive waste management. Only 10% thought their state of knowledge about either one of the subjects was good.

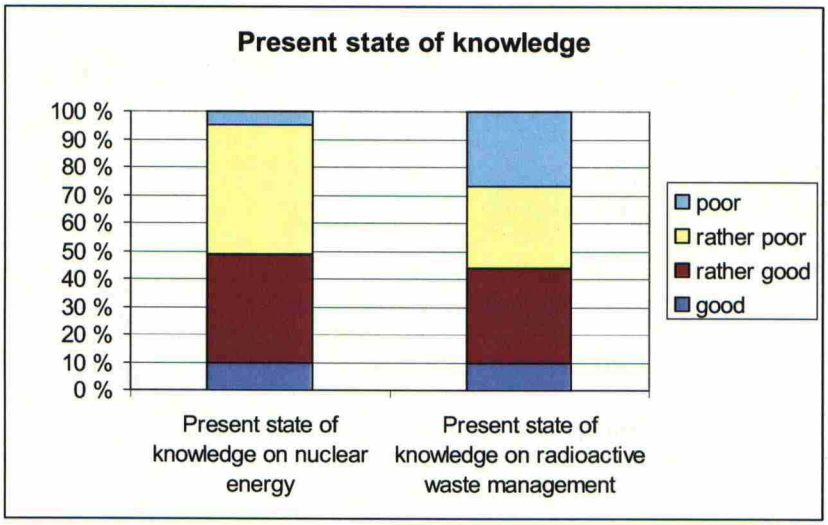

Figure 9. Student's present state of knowledge on nuclear energy and radioactive waste management

In the information meetings and interviews most of the students seemed to know about nuclear energy production and the problems related to nuclear energy, but their knowledge was quite superficial. Only some individuals had prior knowledge about radioactive waste management, but some mentioned that this was the first time they have stopped to think about it as a separate question. Incidents such as accident in Chernobyl in 1986 and the transportation of spent nuclear fuel in Sweden came up in discussions.

5.4.3 Information needs

Need for additional information was asked in the questionnaire using a following phrasing: "Do you see a need for additional information about radioactive waste management in order to form an educated opinion on siting of the final disposal facility in your country?"

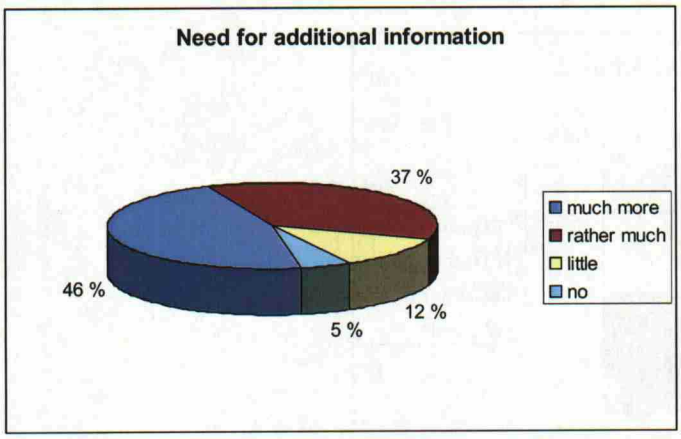

Figure 10. Student's need for additional information

It has to be noted that the question was hypothetical and it does not represent the information needs at the present. Almost half of the respondents (46%) reported having a need for much more information, 37% rather much more information and only 5% claimed to have no need for additional information, if they were to form an educated opinion on siting.

The contents of information needed were covered by two questions on the questionnaire: *About which specific topics would you need more information in order to form an educated opinion on siting of the final disposal facility in your country?* and *Describe what kind of questions you should be able to understand using this additional information?* Below you will find a table presenting the different areas of information and specific topics mentioned by students as well questions related to those areas.

AREA OF INFORMATION	SPECIFIC TOPICS	QUESTIONS
Radioactive waste	scientific processes that make the waste toxic, radioactive and protective substances, radiation, origin/sources, components, utilization, time to make the waste less radioactive	What is radioactive waste? How much waste there is? How much additional waste is going to be created? How dangerous is radioactive waste? Why is nuclear waste such a problem? Why does it have such a bad reputation? Which radioation levels are expected? How high are the radioation levels compared with other radioation? How long does it take until the waste is no longer dangerous?
Radioactive waste management	the latest proposal, different options available, overview of management/final disposal, costs, experiences from other countries, nuclear energy	How can the impacts of waste be controlled? How is the deposition of waste handled in practice? What are the alternatives to final disposal? Why wasn't an alternative solution chosen? Why these things are done and why they need to be accomplished? What kind of studies have been made on enrichment? How is radioactive waste managed in other countries? How could I accept this solution?
Siting	geology, reliability of geological information	Why a particular site was selected? Where does is go? Does the site expand in surface area? How to form an educated opinion on siting of a disposal facility in my country?
Political and legislative issues	legislation, costs and benefits, laws on management and storage of radioactive waste	Is there going to be waste only from Sweden or also from other countries? Is it possible to do business with imported waste? Are there commercial ends or not?
Technology	current state for containment, technical specifications, limitations, copper canisters, tension corrosion (copper canister, cast iron, spent fuel)	Are canisters really prone to corrosion?
Transportation	Method of transportation	How is the waste secured during transport?
Facilities	intoductory nuclear facilities knowledge, risks at the storage facility, specific details about construction, intermediate storage in water basins	How it will be stored?
Risk management	risk associated with storage, risk factors for leakage, long-term risks to humans/environment, things that could go wrong (worst case scenarios), sabotage risks	Have there been problems in the past with radioactive waste? What are backup plans A, B, C, D? Risks associated with storage? What could happen and how? How are risks of terrorists and war handled? Are the risks tolerable and why? In what kind of geological formations/what type of containers the risk would be minimized?
Environment and health	harmful effects/potential risks to environment, dangers/effects to public health and environmental health	Does it effect the surrounding land? How does the waste effect the environment and people? How will I as a local inhabitant be affected? Who is most impacted by final disposal?
Time perspectives / long-term safety	Safety aspects, earth quakes, ice ages	What happens in different timeframes? How long is waste stored for? How long storage containers will last? How has final disposal been assessed as safe? How do I know that final disposal is safe? What kind of safety measures are used to minimize the risks? How are future generations kept out from final disposal site? How are future generations affected? What happens during the next ice age? What kind of studies have been conducted to ensure the safety for thousands of years to come?

Table 6. Information areas mentioned by students

Most of the comments dealt with environmental aspects, the waste itself, risks associated with final disposal and long-term safety. About one third of the students wrote down a very general description about their information need (for example "environmental effects", "safety aspects", "what kind of risks are involved", "what is radioactive waste", "radioactive waste management should be explained better"). Some of the students had clearly a better

understanding about the phenomena to start with, because they were able to ask more precise questions (e.g. tension corrosion, ice ages). Quite a many students wanted to find confirmation for their own attitudes ("how could I accept this solution?", "how do I know that final disposal is safe?"). Because the answers are from students of environmental sciences and risk management, it was expected that the information they would need would deal with these disciplines. Surprisingly, the issues such as decision-making and local involvement were not brought up and most of the issues were technical or natural scientific in nature.

Qualities of the information were asked in respects of user-friendliness, trustworthiness and other expectations concerning the information. The following characteristics were listed as being user-friendly;

- concise
- reliable
- simple
- lot of pictures
- easy to read and understand
- not too technical
- understandable in layman terms
- included in academic programmes so that students get familiar contacts
- easily accessible / internet accessibility
- free
- tailored to different target groups
- be based on a dialogue
- not too much information
- quality not quantity.

Students also think that user-friendliness can also be achieved by using modern information technology and multiple channels in distributing the information. The different channels that were mentioned by students include FAQs with links to more detailed information, interactive questions and answers, possibility to ask from an expert, chat, educational programs on tv, information meetings and written text in different languages

For the information to be trustworthy to students it has to be (i) disseminated by a trusted and impartial source, (ii) the information has to have academic capacities and it has to (iii) deal with both benefits and disadvantages in a balanced way. The source of the information should be independent, it should be known to the recipient who has written it and what are the qualifications of the experts behind the information. It was also mentioned that the authorities should stand by the information in order for it to be trustworthy. About the academic credibility of the information, the students listed the following characteristics; referenced to

current, reputable science/engineering sources, the procedures for determination should be clear and applicable anywhere to obtain same results, peer reviewed, references to trusted studies and ability to find thorough research reports. The final point about dealing with both benefits and disadvantages was also brought up by some students. They think that the information should openly discuss also the possible disadvantages, risks of misuse and how these risks are handled. Finally trustworthiness was described by adjectives such as honest, transparent and objective.

Other expectations the students have regarding the quality of information include getting a general overview of the whole question, involving different perspectives from different stakeholder groups (including NGOs) and choosing the right level of disseminating the information so that everybody can understand it.

5.4.4 Preferred ways of access

Students were asked in the questionnaire in which way they would like to receive information on nuclear waste in the future from the Observatory. The question was open-ended, so there were no alternatives to choose from. This issue was also discussed in the information meetings before distributing the questionnaires. Three information channels, which were most frequently cited were a newsletter via email, a printed brochure or pamphlet (with information and internet links), and a home page. Documentaries, training programs on tv, publications and articles in journals and mass media as well as seminars were also mentioned. Some respondents also stated that they would not like to get any information from the Observatory.

When asked how and from which sources they would seek for information that would satisfy their interests many different sources of information were mentioned. Different answers can be classified by either the transmitter/"owner" of the information or the channel, which is used to disseminate information. When looking at the different institutions or individuals from whom the students would seek for information scientific sources, such as objective scientists or universities with relevant research, were mentioned most often. Scientific sources were followed (in respective order) by authorities, radioactive waste management agencies, nuclear power plants and NGOs. One person mentioned personal contacts that were working in the field as an information source. When the sources are classified by channel, internet was

by far most often cited. Many students who told they would seek for information from internet specified that the source would have to be trusted or that it would most often be just the first step in information seeking. Other sources include scientific journals, seminars, workshops, text books/library and mainstream media.

When students were asked from which sources they have gathered information on nuclear waste management so far, school and university related sources were by far most important with almost half of the students naming school as their source of information on radioactive waste management. School related sources include specific courses, references made during courses and in course readings and books. Another important information source was mass media. When the media was specified it was mostly printed magazines and newspapers as well as scientific magazines. Tv and radio was also mentioned a couple of times. Other sources the students had used to seek information on radioactive waste management, but were mentioned only in separate occasions, include the internet, industry (especially visits to Forsmark nuclear power plant), government and authorities, NGOs, seminars or public information lectures, scientific journals, internships and personal contacts with people they know. It has to be noted that few students told they have not received information on radioactive waste management from any information source.

5.4.5 Radioactive waste management in education

Almost half of the students said radioactive waste management issues have not yet been covered in their education. About 30% reported that radioactive waste management has been brought up in their education in some way. The ways in which the issue has been brought up included courses (e.g. physics, chemistry, geology and environmental sciences), voluntary seminars and internships. According to group discussions, radioactive waste management has been used as an example especially in environmental sciences and risk management but the example has been passed fairly quickly and radioactive waste management as a whole has not been covered in any of the courses. It was surprising that even though radioactive waste management has not been covered very much in the education, still half of the students named school / university as their primary source of information on radioactive waste management so far.

When asked about how radioactive waste management issues could be covered in the education in their own university, 37% of all respondents said it could be added to the curriculum as a course dealing solely on radioactive waste management or as a part of a course (e.g. environmental or energy courses). Other suggestions include seminars, panel discussions, research projects or workshops.

6 CONCLUSIONS AND SUGGESTIONS

This study aimed at finding out the information needs and preferred ways of access to information of local communities as well as students and professors in social and environmental sciences. Based on the findings, it was intended to give suggestions for a practical approach of a pilot observatory. The study was conducted reviewing mainly Finnish and Swedish studies on information needs during the siting phase, and students and professors in Sweden were interviewed for the study. Because the cultures and also cultural value judgements and political situations are different in each European country, the results may not be fully applicable in other European countries.

It has to be noted that the study addressed only a small number of groups, which can be identified as stakeholders affected by the decision of siting a final repository. For example such important stakeholder groups as authorities, legislators, media or NGOs have not been addressed in this study. Instead of the observatory or the local implementing company, the decision-making process around the siting of the final disposal facility was thought to be in the center of the stakeholder network in this case. Only the stakeholder groups addressed in this study are presented in the stakeholder network below, but in reality there would be a lot more stakeholders and their interconnections in the network.

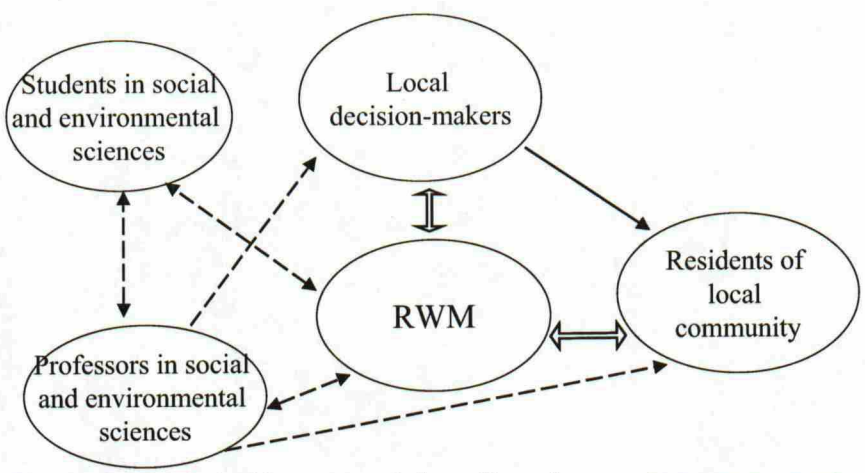

Figure 11. Stakeholder network in radioactive waste management

Out of the stakeholder groups studied here, the local decision-makers have a clear role as normative stakeholders in the stakeholder network. They hold normative legitimacy in the siting process, at least in Finland and Sweden the local decision-makers have a right to veto,

and they also hold normative legitimacy towards to residents of local community. Residents of local community do not have a clear role in the siting process as have the local decision-makers, but their role in the siting decision has been strenghened by the local hearings and the EIA process. It was mentioned earlier that university students and professors in social and environmental sciences are not considered normative stakeholders, since they have no predefined role in the decision-making process, but they can play a role as derivative stakeholders. The professors, or representatives of the academia in social and environmental sciences, can have a strong derivative role in the siting process, though their opinions, studies and conclusions about radioactive waste management and its impacts.

Many of the information needs or themes of information expressed by different stakeholder groups were similar, but there were also differences between different stakeholder groups. Local residents are a quite heterogeneous group. On average, they require very basic information in lay term that is easy to understand. Most of them do not see a need for information in the sense that they would have faced a situation stop, where they cannot continue without additional information. There are also local residents with needs for in-depth information, which is often driven by their attitudes or concerns. Local decision-makers on the other hand seem to be concerned about effects to local economy and needing information that could predict the future effects and local attitudes on which to base their arguments. The information needs of the professors culminated on academic credibility of the information. Radioactive waste management was not a very familiar subject to most of the students and therefore they needed basic information on the subject. The fields they were studying (environmental aspects and risk analysis) were emphasized in the expressed information needs. Only the local decision-makers and some of the local residents seemed to have real information needs in the sense that they would purposefully go and seek for information in order to bridge the gap in their existing knowledge.

The selected stakeholder groups differed in their information practices regarding radioactive waste management. While the information practices of local decision-makers can be characterized as active seeking or active scanning, the information practices of university professors or students were mostly non-directed monitoring. University students and professors, who were identified as target group of this study, can also be seen as having information practice by proxy, when they themselves did not identify themselves as

information seekers in this domain, but they were referred to as stakeholders through gatekeepers, in this case the OBRA-project.

6.1 Suggestions for a practical approach of a pilot observatory

In this chapter, I will give suggestions to the pilot observatory based on the findings reported in this study as to the practical approach. Following Dervin and Nilan's (Dervin & Nilan 1986) general ideas about creating a user-oriented information system the documents should be treated in a way that they are meaningful to users. If one of the objectives of the OBRA-project is to provide mechanisms for all stakeholders to have access to the knowledge that has been generated by successive EU research programs, the indexes should be based on user-relevant criteria and using user-problematic situations.

To have a truly multidisciplinary approach, the observatory should engage different stakeholder groups in its activities from the beginning. One way of achieving this could be using representatives from different stakeholder groups as members of a board overlooking the activities of the observatory. This would also facilitate the marketing of the observatory to possible end-users. A very good allegory from another field to the observatory for long-term governance on radioactive waste management was the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2007). In IPCC over 2000 experts participate worldwide in gathering and assessing existing information. IPCC is open to all members of World Meteorological Organisation (WMO) and UN Environmental Programme (UNEP) and it does not have its own research, but it analyzes and synthetizes existing information and publishes reports for decision-makers. In its own field, IPCC has reached a very strong position as a trusted source of information. In my opinion, this would be the kind of independent party that could provide information on radioactive waste management that would be trustworthy. Creating such a panel of experts in the field of radioactive waste management is probably more difficult than in climate change. Both subjects have political implications, but radioactive waste management is still probably more tied to the industry and lacks credibility. Also many of the considerations of siting a repository for radioactive waste are local in nature and not global like in climate change. There are already certain international organisations or groups of experts in the field of radioactive waste management such as International Atomic Energy Agency (IAEA), the Nuclear Energy Agency of the Organisation for Economic Cooperation

and Development (OECD/NEA), different authorities and functions within the European Commission (EC) and other groups (EDRAM – Environmentally Safe Disposal of Radioactive Materials, WNA – World Nuclear Association, Club of Agencies, Cassiopee, Arius etc.) but they are seen more or less industry-driven. Therefore the financing of the observatory as well as the linkages of the experts needs to be as independent from the nuclear energy industry as possible, so that the observatory would not look like one more group of experts around the industry. Finding suitable experts who have the required knowledge, but are not yet "corrupted" in their other connections to the radioactive waste management agencies will probably be a difficult task.

Next, I will look more closely on approaches and means of accessing the selected stakeholder groups, to meet their information needs and to form a living interaction with them.

6.1.1 Accessing selected stakeholder groups

First of all the observatory should consider who are the target groups for its operations and how active role does it take in disseminating information. Should it become the central point of reference of knowledge acquisition for those stakeholder groups who are actively seeking for information or should it also promote information exchange to those who are not actively seeking for information? The different information practices of different stakeholder groups as well as different information practices between members of one stakeholder group make some of them more easily accessible than others.

Another consideration is whether the observatory should function as a centralized unit or should it also have local operations, which could also serve the needs of information about the implications of siting on the local level. Residents of local communities did express a need for impartial information, but they also value face-to-face information and information that is expressed in layman terms. Therefore to access the public at large, the information should be available in their own language and maybe there should be contact persons who would be locally based. In order to access the local decision-makers, probably the best way to reach them would be contact persons whom the local decision-makers could meet and discuss with. Another way of overcoming local desires for face-to-face information could be marketing the observatory to the experts or representatives of different groups, who meet with local people

during the siting process. Those experts include for example representatives of nuclear power companies, local implementers, researchers, NGOs, national authorities or legislators. If they could trust the information disseminated by the observatory, they could use that as an independent reference when talking to the local public. In this case, the observatory would concentrate on trying to assess the information on radioactive waste management that is the same thoughout the world, but would not be able to provide information on local impacts of the repository.

Professors in social and environmental studies are difficult to access if they are not currently working on issues that would have to do with radioactive waste and they are not using active information practices to get more information on radioactive waste. If they were working on this issue, they would prefer web-based services such as an e-inventory summarizing and synthetizing the on-going research, library, database with definitions and a virtual network or discussion forum provided that they would find the observatory running these services as trustworthy. Many of them also mentioned personal contacts they could talk to or a training or workshop they could attend. Many of the professors had an information practice regarding radioactive waste management that could called non-directive monitoring. One way of reaching this group could be articles in the journals they follow or presentations in conferences they go to.

Students mentioned their university as their primary source of information. Therefore in order to access the students, the observatory could consider some forms of cooperation with the universities or textbook publishers in order to get radioactive waste management issues in their curriculum. Naturally, the professors should be reached in order to access the students. Radioactive waste management could be covered in various courses dealing with for example risk management, environmental studies, environmental law, philosophy etc. Radioactive waste management could be used as an example, as a subject of a case study or seminar work.

Www-pages seem to be a prerequisite for any information dissemination nowadays, but so far only a few of the interviewees mentioned getting information on radioactive waste management from the internet. The people who are actively seeking for information are more likely to use the internet when seeking information, but if also the ones who are not employing active information practices want to be accessed, then other information channels

have to be considered. Those include articles in newspapers and magazines, educational tv-programs and newsletters.

6.1.2 Meeting the information needs of selected stakeholder groups

The starting point of the information should be the cognitive information needs as well as the fears and concerns people have concerning siting of a final disposal facility. In a matter such as radioactive waste management, emotions play a major role in decision-making and therefore they should be taken into account, and understood that the concerns may not be overcome by factual knowledge. In structuring the information, this could be taken into account by indexing the information so that it is easy to find answers to different concerns (e.g. effects on environment, effects on health, socio-economic effects…) or having questions and answers to the most common concerns people have.

In all stakeholder groups, there seems to be a need for a general overview of information concerning radioactive waste management. Regarding the low level of knowledge about radioactive waste management (for example over half of the students rate their knowledge on radioactive waste management as poor or rather poor) there is a need to have a very basic overview on the subject in lay terms in order to be able to follow the discussion. The definitions to basic terms should also be provided. Another kind of need for a general overview was about the status of knowledge; what is known and what is not known. Tools such as pedigree analysis could be used here to present the status of the research and to assess the quality of information. Pedigree analysis could evaluate the information by scoring different attributes of information such as theoretical understanding (widely accepted theory or only rough estimates?) or unanimity among researchers (is it accepted by most researchers?) (van der Sluijs & al. 2005). An assessment report prepared by a panel of independent experts assessing and synthetizing the existing research could also serve as a general overview provided that the independent experts were trusted and the panel was supported by all stakeholder groups.

At the same time, when there was clearly a need for a general overview, there was also a need to follow the roots of information. The information and the way the information has been generated has to be made transparent to the recipient by providing references, telling who has

written the text, what are his / her credentials and affiliations, as well as telling how the facts have been obtained (e.g. how the risk analysis is made).

Different information areas or themes have been expressed by people who were studied for this research or previous studies. Most of them are already covered in existing studies as well as in information brochures and www-pages focused to the public. By many interviewees, the lack of available information is not the problem, but finding information that would be trustworthy and impartial. In order to fulfil these prerequisites, the information should be transparent and go through some kind of review process before being published. One form of peer review is an extended peer review process, which incorporates also the non-experts into the review (van der Sluijs et al. 2005). Another way of getting a balanced view of siting would be to have representatives of different stakeholder groups answer the same questions about siting a final disposal facility. The questions could be about how different stakeholders rate the trustworthiness of given information, what kind of benefits they see in siting to a particular place, what they regard as the biggest unresolved issues and so on. Afterwards it should be possible to compare the different answers with each other.

Actually, many of the needs expressed here relate to needs for knowledge rather than information needs, since synthetizing and networking is required to come up with the sort of material (Davenport 1997). Knowledge is often tacit, which is difficult to put into an information system, so the information system on internet cannot alone satisfy the information needs.

6.1.3 Forming a living contact interface with selected stakeholder groups

Forming a living contact interface requires an active information practice from stakeholders, not just that they have perceived a need for information, but they also have to take active measures to bridge the gap in their information.

In practice, a living contact with stakeholders can be achieved by a discussion forum where different groups can interact with each other. Good example of an existing resource where the issue of climate change is discussed in a balanced way among experts from different

disciplines is a blog called RealClimate, recommended by one of the interviewed professors. There also, transparency should play a major role, for example in a way that the people who participate in the discussion would register and give basic information about qualifications and affiliations.

As many of the stakeholders studied here seemed to appreciate face-to-face information, having contact persons or chances to meet and discuss with other stakeholders personally. This facilitates forming a living contact interface with different stakeholder groups. These situations could be arranged in training sessions, workshops, seminars or focus group discussions arranged either on European level or local level.

6.2 Suggestions for future research

This study dealt with only a small number of stakeholder groups. On behalf of local communities and local decision-makers this study did not bring new insights since secondary information was used. If the observatory wants to become the central point of reference for knowledge acquisition of the stakeholder groups, experts and the general public, also the information needs and preferred ways of access of the other stakeholder groups such as authorities, media, NGOs, politicians and decision-makers at the national level should be investigated.

Once the observatory is in operation, it would be interesting and valuable for the observatory to study the experiences of end users to find out whether their information needs were satisfied by the information they received, whether the information was regarded as trustworthy and whether the objectives of collaboration and interaction between stakeholder groups and combining multi-disciplinary knowledge were met.

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8 ANNEXES

ANNEX I - INTERVIEW STRUCTURE FOR PROFESSORS

Information needs

- How would you describe your present state of knowledge on nuclear energy in general / radioactive waste management in particular? What do you understand by radioactive waste management and nuclear waste?
- What kind of information would you need in order to form an educated opinion on siting of the final disposal facility in your country?
- Do you see a need for additional information about radioactive waste management in your current work setting or other social setting? Describe what kind of question you would like to be able to answer using this information. What kind of expectations do you have concerning the information (breadth, depth)?
- Have you experienced a gap in your information on radioactive waste management? Are you going to bridge that gap? How? If you are not going to do anything, why not? What is the value of that information to you? Have you experienced a situation where your way ahead is blocked due to lack of information? In what ways would bridging the information gap help you in your work / other social settings?
- Describe your information seeking strategy? Think about an instance in your work setting when you last had to purposefully search for information in order to change your state of knowledge? How did you go about doing that?
- Which specific areas of information on radioactive waste management would be of interest to you?

Preferred ways of access

- From which sources have you gathered information on nuclear waste management so far?
- How would you go about seeking for information that would satisfy your interest related to radioactive waste management?
- In which ways would you like to receive information on nuclear waste in the future from the Observatory?

- Which methods of teaching or sources of information would you like to use with your students, that would incorporate radioactive waste management into the education?

Way ahead

- Do you have a student group starting next fall that could be used as a target group for this study?

Background information

- Age
- Sex
- Occupational information (university, faculty, field of expertise)
- Opinion on nuclear energy and final disposal of nuclear waste (pro/con/neutral)
- Affiliation with agencies, companies, organisations or experts dealing with nuclear industry
- Have radioactive waste management issues been covered in courses you teach at university? If yes, describe in more detail.

ANNEX II

QUESTIONNAIRE FOR STUDENTS IN SOCIAL AND ENVIRONMENTAL STUDIES

The aim of this questioinnaire is to find out about your information needs concerning radioactive waste management and preferred ways of access to the information.
This survey is part of the Master's thesis done within an EU-project called European observatory for long-term governance on radioactive waste management (OBRA).

1. How would you describe your present state of knowledge on nuclear energy in general?
   ☐ Good ☐ Rather good ☐ Rather poor ☐ Poor

2. How would you describe your present state of knowledge on radioactive waste management in particular?
   ☐ Good ☐ Rather good ☐ Rather poor ☐ Poor

3. Do you see a need for additional information about radioactive waste management in order to form an educated opinion on siting of the final disposal facility in your country?
   ☐ Yes, I will need much more information
   ☐ Yes, I will need rather much more information
   ☐ Yes, I will need a little more information
   ☐ No, I do not need additional information

4. About which specific topics would you need more information in order to form an educated opinion on siting of the final disposal facility in your country?

5. Describe what kind of questions you should be able to answer using this additional information.

6. What the information should be like in order to be
   - user-friendly?

   - trustworthy?

- other expectations concerning the quality of information?

7. From which sources have you gathered information on nuclear waste management so far?

8. How and from which sources would you seek for information that would satisfy your interests related to radioactive waste management? Describe.

9. In which ways would you like to receive information on nuclear waste in the future from the Observatory?

10. In which way radioactive waste management issues could be covered in the education at your university?

BACKGROUND INFORMATION

Age _____ years

Sex ☐ male ☐ female

University

_____

Faculty

_____

Field of study

_____

Opinion on nuclear energy ☐ pro nuclear energy ☐ neutral ☐ against nuclear energy

Opinion on final disposal of nuclear waste
☐ pro final disposal ☐ neutral ☐ against final disposal

Has radioactive waste management issues been covered in any way in your education? If yes, describe in more detail.